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THE CONVENTION OF THE INDEPENDENT TELEPHONE ASSOCIATION.

During the past twelve months legal disturbances in the telephone field have been noticeably few, and the independent telephone movement has expanded with little let or hindrance. The fear and uncertainty that pervaded the telephonic atmosphere prior to the organization of the Independent Telephone Association in Detroit last year seems to have been dispelled, and the independent movement has been marching on in a peaceable conquest. The threats of offensive action on the part of the older company which so long hung over the spirit of independence seem to have quieted down, and it is but reasonable to suppose that the unpleasantness has been largely neutralized by the defensive attitude of the national independent organization, which is composed of men firm in their belief in the justice of the cause for the defense of which they are banded together.

At last year's meeting it was shown that at that time there were in use between 150,000 and 175,000 independent telephones, supplied by about 1200 exchanges. This information was no doubt a very gratifying surprise to even many of the members themselves, and when the report of progress during the first year of the association's existence is added to it we will without question witness a splendid result of harmonious co-operation in a worthy cause. Interests of such vast magnitude as independent telephony has proved to be must needs be protected against the attacks of an older and more strongly intrenched competitor. The Independent Association exists for a well designed purpose, and that it is doing efficacious work is evident from the actual progress that has been made in the independent field during the past year, with so little molestation.

IMPROVEMENTS IN TELEPHONE EXCHANGE SYSTEMS.

Probably the greatest improvement in telephone exchange work made during the past few years is the development of various so-called common-battery systems, by which the troublesome primary battery at the subscriber's instrument is done away with and all subscriber's microphones are supplied with current from one common source, generally a storage battery, at the central exchange. Associated with this improvement, which necessitates the use of battery current on the subscriber's line, is the elimination of the hand generator at the subscriber's instrument, the signaling to the central exchange being readily effected by a variation of the resistance of the line, caused by the motion of the telephone hook or any other manipulation on the part of the subscriber, the corresponding change of current affecting generally a relay at the exchange, which in turn operates the signal. The most up-to-date form of this signal is the miniature lamp, its advantages being that it has no moving parts, that it is instantly restored on the removal of the current and that it requires very little space on the board.

The enormous banks of these relays, with their two extensive systems of wiring, one on the line and one on the lamp side, are, to be sure, somewhat troublesome, but no more so than the corresponding banks of self-restoring drops which they replace. A further improvement, which may be confidently hoped for, is the substitution for these relays and low-voltage lamps of fine filament lamps directly in the line circuits. Incandescent lamp works now turn out filaments which incandesce with 300 milliamperes or

even less, and could no doubt make the filament much finer in the short lengths and low-candle powers and low economies allowable in this work. Such filament would of necessity be cut into the lines instead of bridged across them as are the relays now used. With these visual signals mounted, as both convenience and simplicity would suggest, adjacent to their respective answering jacks, one multipling of the boards would be done away with.

Common battery systems are not as yet developed to work as well as the more old-fashioned individual battery systems, owing to the insertion of the comparatively high resistance of the line in the microphone circuit. There are various ways of partially overcoming this, varying from the use of a simple shunt about the microphone to the use of a storage battery charged over the wire when the latter is not in use for talking. Systems that require the use of more than two individual wires to each subscriber may be set down as impractical, and even those requiring the use of a common lead in addition to the separate line and return of each subscriber are objectionable.

WATER POWERS IN NORTHERN LATITUDES.

It may be recalled that when the great power plant at the Lachine rapids, near Montreal, was opened about a year ago, there was some feeling of uncertainty as to the continuous working of water powers in latitudes where the winter temperatures are so low as in that part of Canada. It is fairly demonstrated from the past winter's operation of the Lachine plant that this fear was without adequate foundation, as no trouble from anchor ice was encountered and the service of the installation was not hampered in any way by ice during the winter season. A large part of the available water power in the eastern part of America is in northern latitudes where the winters are of great severity, and it is as important as it is pleasant to know that there seems to be no reason to anticipate stoppage of the power from ice. The industrial development of Canada will probably keep pace with the utilization of the magnificent water powers with which it is so abundantly endowed, the climatic and other conditions apparently marking Canada as a region in which manufacturing will one day be the principal industry. The projected railway to the Hudson Bay region will open a country full of water power awaiting development and utilization, and this region is not so far from the centres of population and the points of trans-shipment for export as some others now enjoying a large manufacturing trade.

With the continual growth of electrolytic methods for the extraction of metals and the manufacture of mineral products the importance of water powers, even in comparatively inaccessible regions, is vastly enhanced. This is especially the case in a region of high-priced coal such as Canada, and it is to be hoped that the encouraging success of some recent great installations for the electrical development of water power there may be followed by a general attention to the development of the vast resources of the country through the agency of its fine natural falls.

ELECTROLYTIC METALLURGY.

In no branch of applied electricity has such progress been made in recent years as in that of the extraction and refining of metals by electrolysis. Aluminum has practically been given to the arts by the agency of electrical methods for its reduction from its very refractory ores, and the electric furnace and cell hold out promise of being immediately available for the production of other useful and valuable metals. Among these none possesses more interest to the electrician than glucinum or beryllium.

This remarkable metal is lighter than aluminum, is to all practical intents and purposes unoxidizable, and possesses an electrical conductivity higher than that of copper. It has been obtained without great difficulty by the electrolysis of a double glucinum-sodium fluoride. What use can be made of it will, of course, be largely determined by the price at which it can be produced, but its lightness, resistance to oxidation, and high conductivity mark it as useful to the instrument maker and for many purposes where the combination of these qualities will be found desirable.

Sodium, which has found a considerable application in the arts, is now generally made by an electrolytic process, the chloride being used as the electrolyte and chlorine made as a by-product. The price of this metal has been reduced very greatly, and its usefulness correspondingly extended since the introduction of the electrolytic method of manufacture. Phosphorus, while not a metal, is another electrolytic product of great importance, its principal use being in the manufacture of matches, in which large quantities are consumed.

Perhaps the most important electrolytic product is copper. This is either reduced directly from its ores or refined by the electrolysis of anodes of the crude metal, enormous works of both kinds being in operation in many parts of the world. The increasing demand for copper of high conductivity, which is another way of saying of great purity, has made a ready market for the electrolytic product and contributed greatly to the extension of such processes. Aluminum as an electrical product is too well known to require further mention here. Electrolytic lead is now an article of staple manufacture and of great importance. The lead is not often directly reduced from its ore by electrical means, but, as the metal is almost always more or less contaminated by foreign and injurious impurities, its refinement by some process is generally necessary. Of the various methods adopted for refining lead none are more promising and important than those based upon electrolytic action.

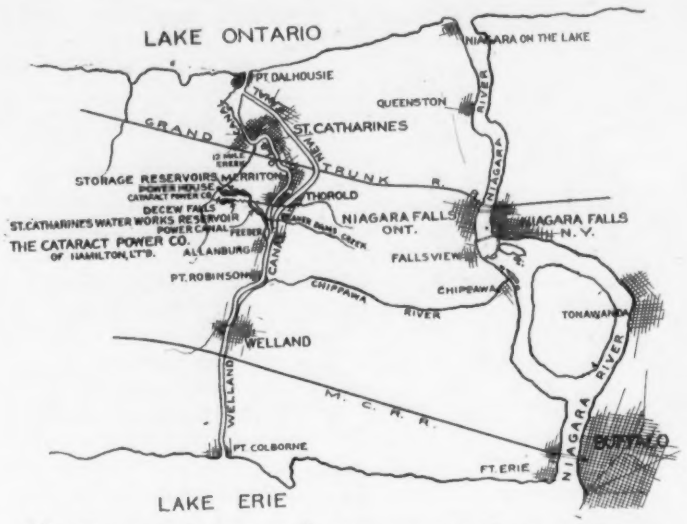
THE SEARCH LIGHT IN WAR.

An instance of the value of the search light in war was shown during the recent occupation of the shores of Guantanamo Bay by the American marines. The camp of this force was greatly annoyed at night by persistent firing from the dense thickets surrounding it, and as the nights were very dark no effective reply could be made. The search lights of two or three vessels lying in the bay were turned upon the woods in which the Spanish sharpshooters were concealed, with the result that they were located and driven out with comparative ease.

Probably the first use of search lights in actual warfare was during the landing of the Japanese forces near Seoul, Korea, at the beginning of the late war between Japan and China. On this occasion they were found to be exceedingly effective, not only in illuminating the shores and waters where the landing was taking place, but also in terrifying the semi-savage soldiery defending the coast. While it is not likely that the search light will be found useful in this way during our present war, there is no doubt that it has already proven its capacity as an effective addition to the materials of warfare in more than one instance. Its use, confined hitherto almost entirely to naval operations, should be extended to land warfare as well, and it is easy to see how effective the powerful beam might prove to be in night operations ashore, either in guarding against surprise, finding and relieving the wounded after a battle, burying the dead, constructing fortifications, or deceiving and blinding the enemy. Portable search light outfits are in use in the continental European armies, and may be easily and rapidly constructed. Such an outfit, consisting of a light vertical boiler mounted on a wheeled truck, a small high-speed engine and direct-connected dynamo, and the projecting apparatus, can be operated in any region where there are fair roads, though it is likely that it would be of but little use in the mountainous country of southeastern Cuba.

The Cataract Power Company's Transmission Plant.

The Cataract Power Company, Hamilton, Ont., is engaged in a work of great magnitude, and will, when its plans are carried to fruition, generate electricity on a large scale, with a view to supplying electric light and power at any point along the route of the line, which runs from St. Catharines to Hamilton, a distance of 35



MAP SHOWING SOURCE OF SUPPLY AND THE PROPOSED CANAL

miles. Much interest is being taken in the scheme, owing to the fact that it is the first attempt in Canada to transmit power at such a distance.

The plan of the company is to obtain a water supply from the old Welland Canal at Allanburg, and carry it by means of an artificial channel, 4½ miles in length, to the brow of the mountain overlooking Twelve-Mile Creek, just east of DeCew Falls and about 2 miles from St. Catharines. At DeCew Falls a very large reservoir is in course of construction, and other storage reservoirs are being built between DeCew Falls and Allanburg, so as to provide an abundant supply of water. The water will be carried to the power house from the reservoir through pipes 8 feet in diameter, the fall being 275 feet. The power house has already been erected at DeCew Falls.

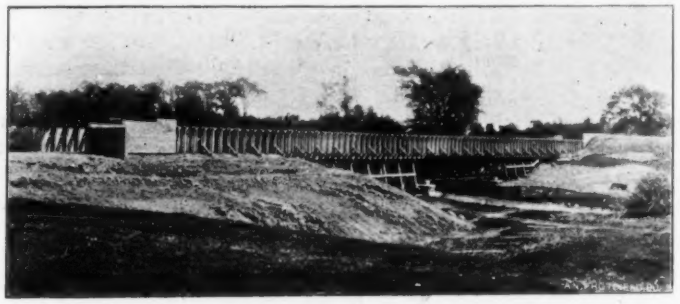


FIG. 2.—AQUEDUCT OVER BEAVER DAM CREEK.

The old and new canals come together near the village of Allanburg, and it is near the junction that the tap is made to permit of the water being utilized for the driving of the power generators at DeCew Falls.

In Fig. 1 are shown the head gates at the intake, of which there are two. From the head gates the water is conducted through an artificial channel or canal. For a distance of 2 miles from the intake the canal is now practically completed. About 2 miles from Allanburg a large aqueduct has been erected for the purpose of carrying the water across the creek, as shown in Fig. 2. This aqueduct is a wooden flume 600 feet in length, with an inside diameter of 8 x 8 feet, and is supported by a steel truss. Considerable work is yet to be accomplished to carry the water from the flume to the brow of the mountain, and to do this numerous small bridges are in course of construction. It is the intention of the company to provide three large storage reservoirs, one of which is already completed. These will contain sufficient water for two days' operations, and the danger from frazil or small particles of ice getting into the water wheels will be provided against. There will also be built at the brow of the mountain a concrete wall 600 feet in length and 15 feet high. A cutting 38 feet deep and 14 feet wide was made in the rock at the top of the bank, in which the pipe line will be placed. This cut, together with a view of the power house, is shown in Fig. 3. The distance from the top of the mountain to the base of the power house is 900 feet, the vertical height being 275 feet, as already noted. This gives a head nearly double that of Niagara Falls, and a pressure of 135 pounds to the square inch.

The foundation for the pipe line is made of stone, with a pier and drain every 12 feet. At the top of the line the pipe is three-eighths of an inch in thickness, gradually increasing to 1 inch. It is a circular steel tube, the first section being 9 feet in diameter, and then it diminishes to 8 feet 6 inches, 8 feet, and finally 7 feet 6 inches. The pipe was constructed by the Hamilton Bridge Company, and is said to be an excellent piece of work.

The power house is located on the bank of Twelve-Mile Creek, into which the water will discharge directly. It is 175 feet long by 40 feet wide, the walls being 30 feet in height. The framework is of steel filled in with brick. The roof is covered with lap seam metal and the floors are of concrete 3 inches thick, but where the generators and turbines will be located it will be laid to a depth of 12 feet. At the present time no machinery has been installed, except a large traveling crane. Four generators will be placed on the north side, as well as two exciters. All of the electrical apparatus is being constructed by the Royal Electric Company, of Montreal, and is now nearing completion at the company's works. The water wheels are of special design, and were built by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio. They have steel

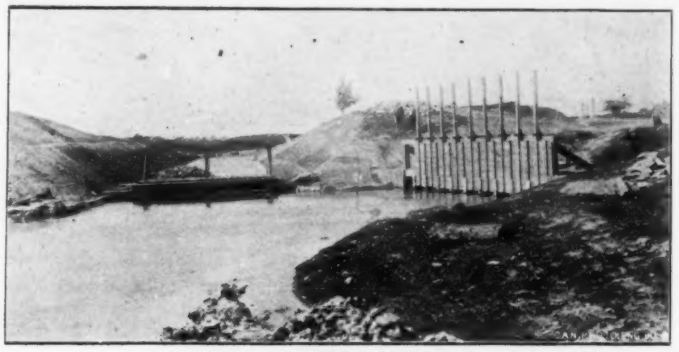


FIG. 1.—THE HEAD GATES.

fly wheels weighing 7½ tons each, the total weight of case and turbine being 30 tons.

At the power house current at a pressure of 22,500 volts will be generated and transmitted to the transformer station at Hamilton,

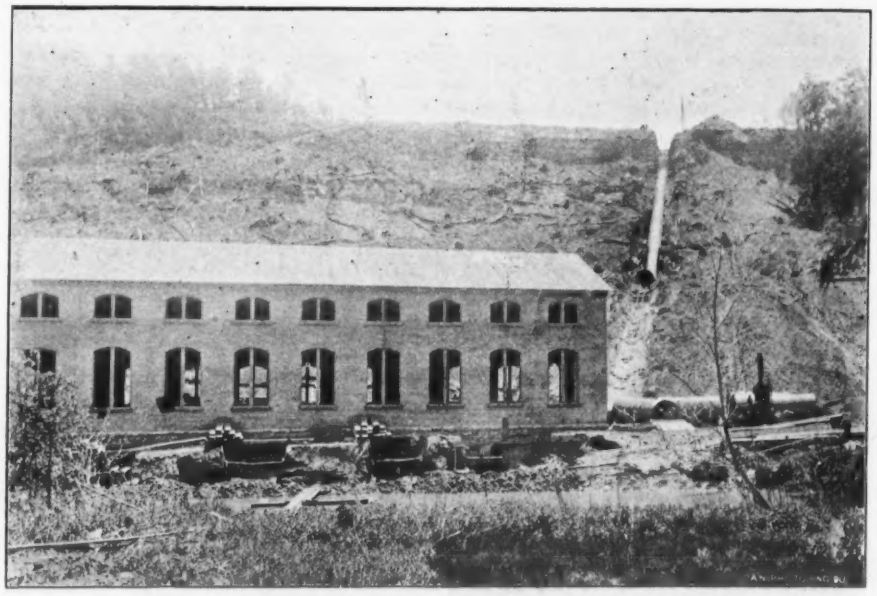


FIG. 3.—POWER HOUSE AND PIPE LINE.

where it will be reduced by step-down transformers to 2500 volts. The pole line has been completed for a distance of about 25 miles.

Cedar poles 35 feet long are being used, with heavy cross-arms and locust pins boiled in linseed oil to extend their life and increase their insulating qualities. A neat angle iron brace gives additional support and strength to the cross arms. Porcelain insulators tested at a very high pressure will support the conductors, which will comprise four separate strands of No. 4 B. & S. copper wire. The poles are placed 90 feet apart, and about 2000 of them will be set in the distance between the two places.

The transformer plant at Hamilton is 50 x 100 feet, and in construction will be similar to the power house. It is now nearing completion.

The cost of the completed work, it is stated by the "Canadian Electrical News," from which journal we obtained most of the foregoing facts, will be about $600,000. The company expects to transmit current for lighting and power purposes to Hamilton before the close of July. The general manager of the Cataract Power Company is Mr. H. R. Leyden, late of the Royal Electric Company, and Mr. T. E. Hillman is the engineer in charge.

Fig. 4.—Pipe Line Showing Heel.

Prospective Water Power Development at the Head of Lake Superior.

In connection with the recent visit of the Northwestern Electrical Association to the cities at the head of Lake Superior, a brief account of the proposed development of the mammoth water power existing near these points may be of interest.

The St. Louis River, which flows into the western tip of Lake Superior, has a length of about 125 miles and is fed by a number of smaller streams which have their sources on the upper plateaus north of the lake and at an elevation of about 1000 feet above it. Reaching a point about 20 miles from Duluth, the river flows in a series of rapids with a total fall of about 450 feet in a distance of 5 miles. The utilization of these falls has long been proposed, but never accomplished, partly on account of the scattered and inaccessible location of the falls and partly on account of the variation in the flow, the river being quite torrential at certain times, especially in the spring, and the flow falling to a comparatively small amount in seasons of drought or continued freezing.

A company has been working at the solution of these problems for some years and has some projects for getting around the difficulties which are of interest because of the boldness of the ideas involved. This company proposes to add to the watershed drained by this river an adjacent large watershed, containing a large amount of open water, which by means of dams could be utilized for storage purposes, giving a superficial area of water of about 35 square miles with a storage depth of perhaps 5 to 8 feet. This would give, at the 5-foot depth, an available storage capacity of nearly 5,000,000,000 cubic feet, or an equivalent of about 1000 cubic feet per second during the period of extreme low water in the winter. By this means the minimum flow of the river at the rapids could be raised from its present volume of about 1000 feet per second to about twice that amount.

The dam mentioned would be about 1300 feet long at the crest, with a maximum height of about 30 feet for a short part of its length, and would probably be constructed of crib work filled with loose stone. There would also be required a canal to connect the new watershed and storage reservoir with one of the tributaries of the St. Louis River.

For the utilization of the maximum available head at one convenient location, the company proposes to construct around the falls above mentioned a canal about 22 miles in length, ending at a point on the hills immediately back of Duluth, from which water would be taken in closed pipe lines to a plant at the river side below, giving a head of about 600 feet. This, with the flow of 2000 feet per second, would develop efficiently about 100,000 horse-power. The power canal mentioned would be of sufficient size to pass this water with a velocity of about 3 feet per second, or, in other words, it would have a cross section below the water level of 667 square feet. It is proposed to make this an earthwork canal, following closely the profile of its own gradient through the hilly country and crossing whatever valleys are unavoidable by following their sides back to points where they could be conveniently crossed by means of masonry or concrete dams on the low side, backing up the water in these valleys for storage purposes and absorbing in this manner the flow of all streams crossing.

Estimates have been made, based on careful surveys, both for this complete plan and others more modest, based on the construction of a shorter canal for the use of a lower head or the utilization direct of the various falls by means of scattered power houses. These estimates run from about $1,500,000 for the simpler plans to $3,500,000 for the complete plan, with mechanical and electrical apparatus for the development of 25,000 horse-power. While the local development of power at the various rapids and falls on the river would give sufficient power for all immediate demands, the later development of the whole head by means of a canal would render all such local plants valueless, hence the advisability of starting in the extensive way proposed.

It is estimated that 20,000 electrical horse-power could be marketed which, if sold at $40 per hp year, would bring an annual revenue of $800,000, and that an income of about $150,000 annually could also be derived from the transportation of pine timber, making an annual income of almost $1,000,000.

The market for power is exceptionally good, there being two extensive street railway systems, two extensive lighting systems, and a large number of elevators, flour mills, etc., all now using bituminous coal at a cost of $2.25 per ton.

Convention of Railway Telegraph Superintendents.

The annual meeting of the Association of Railway Telegraph Superintendents of America was held at the Hotel Dellone, Omaha, Neb., on June 15 and 16. There was a large attendance, and several papers of special interest to the members were read by different ones of their number. The election of officers for the ensuing year resulted as follows: President, W. W. Ryder, of the Chicago, Burlington & Quincy Railroad, Chicago; vice-president, L. B. Foley, of the Delaware, Lackawanna & Western Railroad, New York; secretary-treasurer, P. W. Drew, of the Wisconsin Central Railway, Milwaukee, Wis. The next convention will be held at Wilmington, N. C., on June 19, 1899.

Following is a list of the papers read: "Unnecessary Telegraphing," by Mr. C. S. Rhodes; "Railway Telephone Service," by E. A. Chenery; "Telegraph Construction and Maintenance," by Kenneth Mackenzie; "The Telegraph Block System," by H. C. Hope.

At the second day's meeting, Mr. Wendell Baker, of the Long-Distance Telephone Company, New York, described the extensive telephone system of the Pennsylvania Railroad Company, which connects its main offices in Philadelphia with its branch offices in the cities of Philadelphia, New York, Harrisburg, Altoona and Pittsburg; in all of which points prompt connections can be made with the railroad offices or public exchange customers.

The committee on low-resistance-relay experiments made its report on its work in determining the relative advantages of relays of low resistance and standard relays, of which the resistance is 150 ohms. The committee states that in every instance where low resistance relays have been experimented with the wires work much better. The committee was ordered to render a supplementary report at the 1899 meeting.

Lightning Arresters.*

BY A. J. WURTS.

My attention has been called to the large number of inquiries that have been made within the last year or so with reference to the protection of electrical apparatus against lightning. At the late Electrical Congress held in Geneva a little more than a year ago a special effort was made to obtain information on this subject, and about a year ago one of the electrical societies in Berlin offered a considerable prize to its members for the best paper on lightning arresters. Not very long ago the president of a very large electric plant wrote to me and asked whether I thought it possible to absolutely protect a plant against lightning. I answered that I thought it could be absolutely protected against all ordinary effects of lightning, although there are exceptions, of course. Quite recently I have noticed a small article** in one of the electrical papers referring to a meeting held in Johannesburg, South Africa, and to a paper read there on lightning arresters, where the impression seemed to prevail that the subject was not very well understood.

A. J. WURTS.

This subject deals largely with the static spark. In the lightning we see it in its grandest and most beautiful form. It is important in discussing a subject of this kind, which has been treated both in practice and in the laboratory, to establish the value of the laboratory experiments. The question is this: Are the experiments and the deductions that we obtain working with a static machine fair in connection with lightning arresters which we use in our electric light plants? It seems to me that they are. The phenomena that we observe in the laboratory correspond with those which we obtain from a static discharge from our wires. In practice, during a thunderstorm the discharge does not occur from any one particular point. It will occur from this point or that point, according to the conditions. In the laboratory tests I have sent discharges into one of two parallel wires and found that they may jump to the other almost anywhere along the wire. It seems to be because the static charge, which is in the wire during a thunderstorm, surges back and forth in such a way that the waves collide with each other. To illustrate, take a trough of water and lift one end of it; lower it, and the water will surge back and forth in the trough. Raise the end of that trough again, and you get another set of waves. Under certain circumstances the waves will collide, pile up and cause a splashing; under other circumstances, owing to a balancing of the waves, a smooth place will be formed. That is similar to what occurs in the wires. There is a splashing, and the static discharge tends to jump from the wire at those points where the splashing occurs. It seems to me that the wires are charged by conduction from the atmosphere, because they become charged, not only during thunderstorms but also during perfectly clear weather. The wire becomes a part of the electrically charged atmosphere, and, as I have explained, sparks tend to jump from the wire to the ground through any path that they can find.

What is the easiest path for these discharges, and how shall we judge one kind of lightning arrester from another? I wish to speak particularly of two types, one using a spark gap and a resistance in series with that spark gap, the other several spark gaps without any resistance in series with them. The former is on the market now, and it is said of it that the insertion of this resistance decreases the necessity of spark gaps; that is to say, by inserting a resistance a smaller number of spark gaps may be used than could be without the resistance. The question is which one of these paths will offer the least resistance to disruptive discharges. In experimenting in the laboratory I have determined the resistance of lightning arresters by placing in shunt to any given one a variable spark gap. The path of the lightning will depend upon the length of this shunt spark gap. If that gap is closed, the discharge will evidently take that path, and will avoid the lightning arrester, and by increasing the length of the shunt gap until the discharge will pass either through the arrester or through the shunt gap, a point is reached by which the resistance which the lightning arrester offers to the passage of the disruptive discharges may be measured. The length of the spark gap obtained is the measure of the resistance of that lightning arrester.

I have seen several statements in the papers to the effect that the lightning arrester should have a low breaking down E. M. F., that is, if the lightning arrester is to be connected to a 1000 volt circuit it should break down at about 2000 volts. The lightning arrester, as a conductor of disruptive discharges, has nothing to do with the E. M. F. of the dynamo. As far as conducting the discharge away is concerned, if 2000 volts are applied to that arrester using a series resistance the breaking down E. M. F. will be just the same, no matter what that resistance is. It may be 100 ohms in connection with that spark gap, or a million ohms, and it will not make a particle of difference about the breaking down E. M. F., but the resistance will make a great deal of difference as regards the lightning. That form has been called the short gap lightning arrester. It is a very attractive name, and certainly it intimates at once that that offers a very easy path to the passage of disruptive discharges. That is not, however, the case. If we take such a lightning arrester and measure its resistance to the passage of disruptive discharges by means of the shunt gap, and then measure in the same way the resistance of three-spark gaps in series, the dimensions of the gaps in every case being the same, it will be found that the equivalent gap of the device with the series resistance is three times as large as the equivalent gap obtained by the three-gap arrester. The resistance, which is connected in series with these spark gaps, is said to be a low resistance. By what right can anybody call that a low resistance? It is low, compared with what? Lightning arresters, as ordinarily installed, are connected to the overhead wire and to the ground by means of fairly large copper wires of very low resistance, not more than an ohm or so at all events, and the joints are soldered. It seems to me very curious then that in such a path we should connect a resistance of quite a good many ohms. The only standard for the resistance of a lightning arrester is the ease with which it will conduct disruptive discharges to earth, with absolutely no reference to ohmic resistance or breaking down E. M. F.

Lightning is oscillatory, and is not a single passage from cloud to earth. Twelve oscillations have been counted in lightning discharges, and the discharges which we get from our wires have corresponding oscillations. They are consequently resisted by self-induction, but why should they pass with so much difficulty through an ohmic non-inductive resistance? There is a great difference between the static discharge and the dynamo current. The dynamo current is more of a gentle force, and can be likened to the force of wind moving water; the lightning discharge can only be likened to the blow of a hammer or the flight of a bullet. If we have a large pane of glass, ordinary wind will not break it, but a bullet will find no difficulty in piercing it. It is a somewhat analogous force that we are dealing with, and, as I have described the discharge is oscillatory, swinging back and forth. Suppose, to carry out the analogy, we have a body swinging back and forth, and in the path of that swing a pane of glass. That body, in its first motion, will smash the glass, and will then vibrate back and forth until it comes to rest without further resistance. In the place of the pane of glass let us substitute a vessel of water, so that the body that swings back and forth will have to pass through the water. The water is not removed, and the body has got to pass through the water and meet that resistance each time. I liken that water to this non-inductive resistance in series with the spark gap and lightning arrester. The discharge has to pass down through that resistance, up and down, up and down, each time, and the ease with which the discharge passes through it is thereby affected. But with the spark gap the air is smashed, the discharge bores a hole right through the air, as a bolt does through jelly; the resistance is removed. The air has practically an infinite resistance as far as ohmic resistance is concerned, but this discharge bores a hole through the air, and that stays there during these oscillations. That is the reason in my mind for saying that the equivalent spark gap for the arrester with the resistance is so much larger than the equivalent spark gap of the other—in spite of there being three gaps to one. The best path,

*Abstract of an address before the Northwestern Electrical Association, June, 1898.

**See THE ELECTRICAL WORLD, May 28, 1898.

in my judgment for disruptive discharges, is a path with no ohmic resistance, but with simply a spark gap or several spark gaps. The discharge will smash the air and form at once a free path for the oscillations.

I desire to make a few quotations from and comments on some recent articles contained in electric journals, and also from some of the underwriters' rules. One article makes the following statement: The use of better materials in electrical work, paradoxical as it may seem, has undoubtedly increased the trouble from lightning. A poorly insulated circuit, such as suffices for 110 or 220 volt work, allows plenty of opportunities for static charges to leak off or discharge to the ground, but the higher grades of dielectrics and the care taken in the insulation of high tension apparatus, keep such circuits so well separated from the ground that the lightning has to break something to find a path."* What is the authority for any such statement as that? The discharge does not leak down through poor insulating material. It will punch a hole every time it gets a chance. I know of many old dynamos that have poor insulating material on them; that is, such material as would not be used at the present day in the construction of a dynamo, and the discharge goes through it every time, making a pin-hole, and the dynamo current follows. If the discharge will leak down through poor insulating material, why does it not leak down through all the incandescent lamps turned on, through the heavy copper wire connection by metallic strips or wires having a conductivity not less erators? It does not do it. The moment the lightning flash occurs the tremendous electrical strain is broken, and the charge tends to establish a new equilibrium, and gives the disruptive discharge every time.

Referring to the rules and requirements of the National Board of Fire Underwriters, I wish to call attention to a point or two. In reference to lightning arresters they say: "Lightning arresters must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of the No. 6 B. & S. wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection." Why should the Board of Underwriters make such a rule as that, to connect a good-sized copper wire from a line through the arrester, if we are going to put in the arrester an ohmic resistance many times that of the arrester circuit.

In another place they say: "Lightning arresters must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed, and must have no moving parts." I would suggest that it would be well to add: And must offer a low resistance to the passage of disruptive discharges.

The Electrical Industries of Sault Ste. Marie.**

BY F. H. CLERGUE.

After welcoming the association to the town, the author spoke as follows:

The progress of electricity has developed this one fact which is familiar to all of those who are practically conscious of the progress of that science, and that is that the power necessary to develop light, heat or electricity, or any other manifestation of force, must be produced by some method more economical than that of steam power, if it is to be applied to those commoner uses of mankind, such as the production of necessary articles of low intrinsic value which the civilized races put most to their uses—the metals.

We now have before us the manifestation that it is cheaper today to smelt common iron worth $12 a ton in an electric furnace than it is to use coke at $4 a ton for that purpose, to produce the same degree of heat. That is a remarkable statement, but it is proven in the twin cities of the Sault.

You are on a journey of great consequence to the region you visit. It is of importance to this community that you should understand what are our relations to the industry which you especially represent. When you pass these locks you will have crossed the threshold of the most important storehouse of wealth on the face of the globe.

The author then referred to the enormous wheat districts tributary to Lake Superior, the tremendous quantity of lumber available in the wilderness of Canada, north of the lake, and spoke as follows of the metals:

It is a fact shown by statistics that out of this lock, through which you pass to-morrow, there went last year out of Lake Superior 4,000,000 tons more of iron ore than all Great Britain made into pig iron in twelve months of the same year. The greatest in extent and purest in quality of all the iron ore beds ever discovered are those on the shores of Lake Superior. Steel rails in the United States are produced at a cost of from $4 to $5 a ton less than they are in England. It is a fact that at the Sault the first necessary ingredient, except ore, for the production of coke pig iron, viz., coke, could be delivered to smelters here at Sault Ste. Marie at half a dollar a ton less than coke costs delivered to smelters in Great Britain. Steel plates for ship building on the shores of these lakes are produced and delivered at $7 a ton less than in Great Britain. It is true also that within five years the centre of iron ship building will not be in England, but in America. It is true that on these great lakes, at Chicago, Cleveland and at Superior, iron ship building can be done at a cost of several dollars less per ton than is possible in Great Britain.

The next metal in importance is copper. Except the Anaconda mine in Montana, the largest and most productive mines in the world are those you are about to visit to-morrow at Houghton. These copper mines are of native metal, and the only separation required is a purely mechanical one, which means simply the separation of the rock from the metal. It is true, however, that the copper metal, when separated, contains a very appreciable and very valuable percentage of silver. That silver, however, except where it is found in the veins of copper as native silver, has not yet in that region been utilized, and consequently if you were to take down the copper wires of this town and make an analysis of them you would find that the percentage of silver is so large that with silver at a dollar an ounce, you could afford to take the copper wire down and extract the silver. The only practical way of separating the silver from the copper at a profit is by electrolysis, such is is used at the Anaconda mines. We have recently at our works been approached by some of the principal owners of those mines in the Calumet and Hecla regions, with the suggestions that we receive that ore here and treat it by electrolysis. As a result of that inquiry I had an investigation made and the result is that we are now preparing a 10,000-hp apparatus to be applied to the treatment of the ores of the region in which you are now to make a visit; and if our calculations do not disappoint us we expect to use not less than 30,000 horse-power in the reduction of the ores of the Calumet and Hecla district for the purpose of securing the silver contained.

After copper and iron in the series of metals of low cost, that which has at the present time attracted the most serious attention is nickel. Those of you who have given any attention to metallurgy know very well that the American warships, now engaged in trying to settle a little disagreeable difficulty, are clad with a plate called nickel steel. You will also probably know that the American projectiles which are being used to batter down the forts of the enemy are also made with a nickel-steel casing. The reason why nickel is used for that purpose is the fact that a small admixture of nickel, as 2½ to 3 per cent., in a large admixture of iron, if made into steel and properly tempered, produces a substance very remarkable in its tenacity and in its strength against penetration. The United States Government made a very careful investigation of the subject several years ago and as a result adopted that class of armor plate for their modern navy, and for that reason it is claimed by the advocates of the present American navy that they can stand a battering which no other navy could endure and live.

The copper region I refer to is distant from here only about 100 miles; the iron region 200 and 300. The nickel region exists in the territory of Canada, about 150 miles from here. The present process of treating that ore for use in the arts and for the manufacture of nickel steel and other purposes, has been to treat the ore by chemical processes, by which the crude ore from the mine has separated from it first the silver which it contains in large quantity; second, the copper in smaller quantity, and third, the nickel which is the chiefly valuable ingredient. That product costs actually perhaps 20 cents a pound and the present market price is about 30 cents a pound.

Among other ores which we have tested by electrical processes were, of course, those of the nickel district, and we subjected the product to a series of experiments for the production of ferro nickel and nickel steel directly from that ore. This took some years of investigation, and we made careful inquiry among European metallurgists of skill and experience. But the experience of foreign

*The Electrical World, June 11, 1898.

**Abstract of an address delivered before the Northwestern Electrical Association June 11, 1898.

nations in metallurgical processes, as applied to electricity, has been very limited, and we found little advice to be had, and we were obliged to begin here "de novo" to conduct experiments without scientific advice. The consequences of our experimentation so clearly indicated success that during the past winter I thought it was safe to approach the users of nickel steel and ferro nickel to ascertain what market we could secure for this product. The well-known house of Krupp, in Essen, Germany, is the principal user of this commodity in the world, as in the manufacture of guns and armor its output far exceeds that of any other concern. I visited these works and after a rather technical and scientific discussion of the proposed new product I succeeded in imbuing the scientific staff of that great establishment with the belief that our product would be a success, and with sufficient assurances from them of a market for the product, I returned to our works and continued those experiments. The result has been that within the present week I have received cable advices from Krupp's works, announcing its test of the product of our electrical furnaces here in the line of ferro nickel and nickel steel, and they state to us that their technical and practical tests of our production have been satisfactory, and a contract which I had already negotiated with them, dependent upon the samples proving satisfactory, was by cable confirmed, and we are now about to put 20,000 horse-power on the America side to this new use, the production of ferro nickel and nickel steel.

Among the industries which we have also fostered and developed here has been the production of calcium carbide. Acetylene gas you are all familiar with, and to-morrow morning, by the courtesy of the owners of those works, you will have an opportunity of making an examination of the process as in use here. That is another illustration, and a very strong one, of what patient application can accomplish in the science to which you are devoting your lives. Calcium carbide, as produced in the electrical furnaces of two years ago, was not a commercial commodity, because it could not be produced at a price which would permit of its use as an illuminating material in competition with ordinary electric lighting, or with ordinary gas. That was the condition of that industry when it first attracted our attention. We secured the services of some people very practical in your science, and chemists to afford necessary chemical assistance, and began not only a scientific but a practical test of what could be accomplished in the electric furnace in the production of calcium carbide. The result of a year or fourteen months' operation was the invention of a furnace by our electrical engineer, who will read a paper to you during some session of your convention, and this process has resulted in the reduction of the cost of calcium carbide nearly 200 per cent. The result of those experiments has been the organization of a company called the Union Carbide Company, which has effected a combination of all the calcium carbide interests of this continent, capital $4,000,000, and a contract between our company and the Calcium Carbide Company has been made for a period of twenty-five years, for the use of 20,000 horse-power and additional from our canal.

While we began in the electrical industry here in the development of new electrical processes, only two or three years ago, we have already accomplished this much, that we are under contract to deliver 40,000 horse-power for electrical uses, all to be supplied within two years. We have already developed on the Canadian side 20,000 horse-power and are about to undertake the construction of another canal on the Canadian side to produce 50,000 horse-power.

It is the fall of 20 feet from Lake Superior to Lake Huron that has created the existing enterprises here, and which gives us such great hope for the future industrial prosperity of this region.

Cutting Submarine Cables.

The daily press lately have published statements to the effect that Spain has threatened to retaliate by severing the cables between the United States and Europe, in case the United States interrupted telegraphic communication with the Spanish West Indian colonies. In a recent issue of the London "Electrician" the futility of such an attempt was pointed out. It would only result in injury to neutral property, without effecting the desired object, and would inevitably lead to heavy claims for damages, to say nothing about the practical impossibility of breaking some twelve or thirteen cables before those first severed are repaired. It is stated on the authority of one of the Atlantic cable companies that it has transmitted readable code words through a cable 500 miles long, broken about midway, by means of apparatus invented by Mr. A. C. Brown.

General Distribution from Central Stations by Direct Currents—II.

BY LOUIS A. FERGUSON.

Uniformity of pressure throughout an incandescent electric lighting system is absolutely essential to commercial success. To accomplish this different methods have been proposed at different times. It often happens that the original plan of distribution, laid out by the constructing engineer, does not meet the requirements, after several years' growth of the business, for in all cities lighting business may localize at certain special points, and so demand a remodelling of the existing system of conductors, or require some means of correcting for the inequalities of pressure that are due to the unevenly distributed load.

In the Edison systems built prior to 1890, it was customary to introduce in series with each feeder a resistance box, with capacity to carry the entire current of the feeder and of resistance much greater than that of the feeder itself. The resistance box is commonly known as a feeder equalizer. From the end of each feeder where it connected with the mains a set of pressure wires was run back to the station and there connected to pressure indicators. The method of regulating was to designate the feeder supplying the most important district in the system, the standard feeder, and to keep its pressure constant, say 110 volts. Each pressure indicator of the other feeders was differentially wound, so as to receive the pressure of the standard feeder as well as the pressure of its own feeder. When there was any difference of pressure between the standard feeder and a given feeder, the latter's indicator needle would deflect to one side or the other according as the pressure on that feeder was higher or lower than the standard, and if equal to the standard, the indicating needle would stand in the centre. If, then, any indicator showed that its feeder was low in pressure, some resistance would be cut out of its feeder equalizer, and, the resistance diminishing, the volts loss on the feeder would then become less, and thus the feeder could be brought to the same pressure as the standard. If the pressure of the feeder were high, the operation would be the reverse.

With this method of regulation, the entire output of the station must be at such pressure at the station switchboard as will permit the delivery of the correct pressure at the end of that feeder, the product of whose load and resistance is greatest in the system. There are some large stations in America operating to-day on this plan of regulation, notwithstanding that it is an expensive and troublesome one. Another method of regulating, which may be employed where the load is fairly well distributed, is by cutting out the feeders which are high and forcing the current to travel through the remaining feeders and the mains, thus increasing the fall of pressure to the end of the feeders which were formerly high.

The only economical and safe way to regulate in a city where the distances are not abnormally great, and where the load is fairly well-distributed, is to so design the conducting system that it will be self-regulating; that is, so that it will require no change of the resistance of feeders or anything of the kind. A good conducting system should have an ample number of feeders reasonably close together, and the connecting mains should be of generous cross-sectional area.

A valuable adjunct to a station, where there are one or two straggling feeders of great length so located that they cannot be interconnected with the general system so that they may benefited by such connection, is what is known among the Edison companies as the "booster." The "booster" is a direct-current dynamo wound for a large current and low voltage, and is used for raising the pressure of the station and of the feeders which are ordinarily low. The booster dynamo should be series wound and so designed that its voltage will be proportional to the current passing through it, the speed remaining constant. It is connected in series with the feeder, whose pressure is to be raised, and is belted to or directly connected with a motor which drives it at the speed for which it is designed. Its action is as follows: The current passing out on the feeder also passes through the field and armature of the booster dynamo, and an E. M. F. is thus added to that already existing on the feeder due to the dynamos of the general system. As the load on the feeder increases, the E. M. F. of the booster dynamo increases proportionately, and adds to that of the feeder, thus overcoming the loss of pressure due to the increased current in the feeder, which enables the feeder to deliver the proper pressure at its mains. The booster may also be employed to raise the pressure

of a number of feeders which are connected to an auxiliary bus-bar. In this case, the booster would be connected between the main bus and the auxiliary bus, and would carry all the current of the auxiliary bus, raising the pressure of it as its load increases, and decreasing as the load decreases, as described in the case of the single feeder.

In some central stations two or more potentials or pressures are used, certain dynamos working on a bus-bar at one pressure and the other dynamos working on another bus-bar at different pressures. This method is only economical when the dynamos can be worked very near the maximum load, which is not often the case. In some cities the dynamos in central stations or machinery or storage batteries in sub-stations feed into one general system at different points, each station or sub-station operating at such pressure as will deliver the same voltage at the feeder end of the mains. This is, without doubt, the method to be recommended as giving the best efficiency and assuring reliability of service throughout the system. With the method proposed, in case of accident to any one station, either by fire or lack of water supply, the whole system will not be shut down, but each station will take its share of load which comes from the shutting down of the disabled station.

Municipal legislation in all large cities requires, and very justly so, that the wires for the distribution of electricity for lighting and power purposes should be laid underground. The Edison companies throughout the country use a standard system of underground, the mains and feeders consisting of japanned iron pipe in which are three solid copper wires or rods insulated from each other and from the iron pipe by an asphaltum compound. These pipes, or "tubes," as they are commonly called, are 20 feet in length, the copper conductors projecting 3 inches on each end, making the total length of each pipe 20 feet 6 inches.

The copper conductors are connected together by means of a flexible coupling, composed of a stranded copper cable about 8 inches in length, and having copper terminals on either end, and which are provided with a circular opening of such diameter as will permit the reception of the copper conductor of the tube. The copper terminal is heated by the flame from a blow lamp, and the copper conductor is soldered into the terminal.

After the three couplings are connected, an iron ball clamp is bolted onto the tube near the end, and a cast-iron, oval-shaped coupling box is laid over the copper joint and fastened together by bolts and nuts. The coupling box is then filled with hot insulating compound, and after this has settled by cooling, the box is again filled and the opening covered by plugs.

At each street intersection these tubes enter a junction box. The junction box is a cylindrical cast-iron box, in the centre of which is a cast-iron upright standard carrying three rings of flat copper bar. To one of these rings all of the positive conductors are connected, to another ring all the negative conductors, and to the remaining ring all of the neutral conductors are connected in a similar manner.

Many of the junction boxes are fed by a feeder direct from the central station, the feeder, when Edison tubes are used, being laid in the same manner as the mains before described. The feeders in a three-wire system consist of three conductors, as in the case of mains, with the exception that one conductor which is used as a neutral has usually one-third the area in cross-section of either of the two other conductors. Feeder tubes are made in various sizes, from 250,000 centimeters up to 3,000,000 centimeters. Each feeder tube also contains three small insulated copper wires, which are connected in each coupling box to the corresponding wires in the next tube, thus making a continuous circuit from the feeder end in the junction box at street intersection back to the station. At the generating station these wires connect with a pair of voltmeters, and at the end of the feeder they are connected through fusible strips to the copper rings in the junction box, thus giving in the station the pressure or difference of potential at the feeder end. By means of the junction boxes the system becomes one grand network of conductors connected in multiple and fed at many points by feeders from the central station, similar to that of a well-designed gas or water system in a large city. By means of this network of mains the electrical pressure is equalized throughout the system, and the current is distributed properly among the feeders. Every mechanical and electrical detail of the system is very carefully worked out and absolutely interchangeable, and it is without question, when cables are used for the feeders, the most complete, most easily operated, and most permanent underground system yet devised for the distribution of electricity for large cities using a direct-current system of 500 volts and under. With this system the customers are almost absolutely certain to have continuous service, as they are fed from two points under ordinary conditions, and should the main in their block burn out, it is nearly always possible for the company to feed the customers from one or another junction box. The method of coupling affords a perfect house-to-house system of distribution, and renders the placing of services a very easy and simple matter. The system is very easily laid down, and its maintenance compares favorably with other methods of distribution.

The maintenance of good pressure regulation at the customers' meter is very much more easily effected with an interconnected direct-current distribution such as has been described, than with the ordinary alternating-current central station system, such as has been exploited in this country. Owing to the parallel operating of direct-current dynamos and distribution systems, the fluctuations in the pressure, due to change over from one machine to another, so prevalent in the ordinary American alternating-current central station, and so annoying to customers, are eliminated, and a carefully operated direct-current central station should show a pressure chart with an average deviation from the mean of less than 1 volt.

It is possible, of course, and often the careless practice in direct-current stations to have bad fluctuations of pressure at the times of change-over, and also irregularities at other periods, but there is absolutely no excuse for their existence in a well-operated and well-planned direct-current system.

The parallel operating of the generators greatly simplifies the maintenance of uniform pressure regulation at the lamps, since when several units are connected to the common bus-bar the regulation for the entire system may be effected by careful attention to one unit, whereas in alternating-current stations where the generators do not operate in parallel it is necessary, in order to even approach the uniformity of pressure regulation which exists in direct-current systems operating in parallel, to regulate the pressure accurately on each unit, which is seldom done in practice. Besides the better regulation possible with parallel operating of the dynamos, a further distinct advantage is derived from the economy effected by proper division of load among the units in the stations, this being particularly marked when the distribution systems are also interconnected. Each unit, irrespective of size, may be usefully and efficiently employed at the period of maximum load, and the amount of idle or uneconomically employed investment is reduced to a minimum.

To illustrate the comparative accuracy of regulation obtainable in an interconnected direct-current system, and in the ordinary type of independent circuit alternating-current system, let us refer to the pressure charts shown in the accompanying diagrams:

Chart No. 1 represents the pressure for twenty-four hours on the direct-current distribution system in the business district of Chicago, the average deviation from the mean pressure is less than 1 volt.

Chart "H" represents the pressure on one of the circuits of a single-phase, house-to-house transformer, alternating-system in Chicago.

Chart "M" represents the pressure regulation of an alternating-current system on a long avenue, where are used primary feeders with four 15-kw transformers, the secondaries in multiple on the three-wire system.

If the engineer, designing a system employing alternating current in the distribution, expects to obtain first-class pressure regulation, he must follow those lines laid down by the engineers who have developed the modern direct-current distribution system. The distribution system of mains should be interconnected, forming one grand network of conductors with large transformers located at points where feeders would terminate if it were a low tension direct-current system, and to these transformers should be brought the primary feeders from the central station, provided with boosting transformers or induction regulators. Pressure wires from the secondaries of the transformers should be brought back to the station, so that the pressure on the ends of the mains may be known and properly controlled. Such a system is described in the paper by Mr. Wagner, and I am sure he will agree with me when I say that the single-phase, house-to-house transformer, separate circuit alternating-current system, such as has been generally exploited in this country, has nothing to recommend it to the central station

manager, either from a purely engineering or financial standpoint, although it has fulfilled its mission as a pioneer in the introduction of electric lighting in scattered districts.

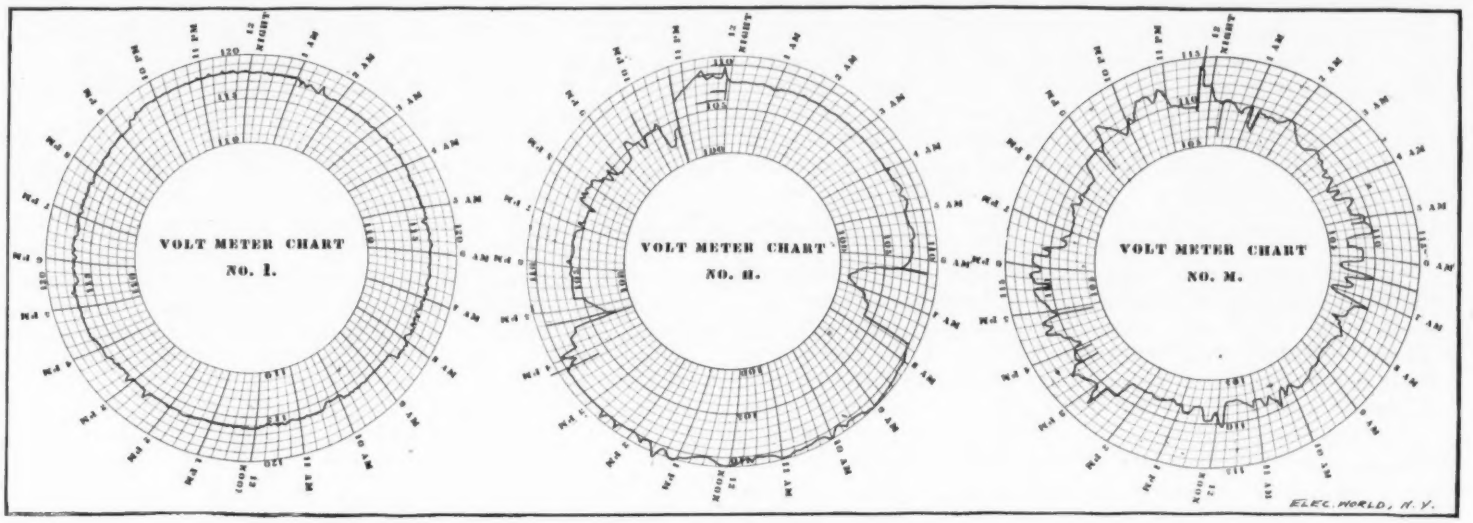
One of the advantages to be derived from the use of direct-current distribution as distinct from alternating-current distribution, is the employment of storage batteries. They may be adopted for use in various ways, in sub-stations in outlying districts where the load factor of the district is very small, in the central stations themselves to deliver the entire output during period of minimum load, at the centres of distribution for discharging during the peak, or as auxiliaries in rotary transformer sub-stations for discharge use at the time of the maximum load in the main central station. In addition to any one of the various ways in which the battery may be employed, it always acts as a reserve, guaranteeing the consumer good service, in much the same manner as a bank surplus is a guaranty to the depositors in cases of financial emergency.

Storage batteries, when installed in central stations or centres of distribution, are usually connected to the main bus and allowed to float on the system taking a charging current from the bus or discharging into the bus according to the load on the system, the generating units being worked at such load as will insure the best efficiency of the entire system.

Batteries are economically valuable in connection with the distribution of direct current in systems whose load curve has an average peak width of not more than two hours, since the investment required for storage batteries to carry the peak having an average width of less than two hours is less than the investment required in steam and electrical machinery to do the same work. The storage battery also has the same value that exists in the case of moving machinery as a reserve in meeting sudden increases of load, provided such increase of load does not continue for a sufficient period to wholly discharge the battery and insufficient time remain for recharging before the ordinary load peak of the system appears at the regularly appointed time. Such a condition is rarely, and I might say almost never, met with, although in rare instances we may approach this condition.

The steam and electrical machinery is rated by the horse-power or kilowatt, and the duration of the load peak does not influence the value of the investment, since the machinery may be operated for the full twenty-four hours at its maximum capacity. The storage battery, however, is rated by the horse-power or kilowatt hour, and the investment is nearly directly proportional to the number of hours during which it discharges the maximum capacity, so that if we required the battery to be prepared to carry the full peak prolonged for seven or eight hours every day the investment in battery would be enormous as compared with steam and electrical machinery to furnish the same kilowatt hours' output. Illustrative of such contingency, let me refer you to the load diagram marked "D," representing the load in the business district of Chicago, December 20, 1897. This is a very extraordinary curve, illustrating the limitation of the storage battery and the possibility of its being rendered ineffective had the early morning peak extended to the arrival of the regular afternoon peak, without affording sufficient time for recharging the battery.

The storage battery has a very distinct value, which is seldom recognized and employed to its full advantage, when located at the central distributing point of a system with feeders radiating to various points in the network. The battery may be provided with two or more end cell switches, so arranged that they may be connected in multiple and feed into the main distributing feeder bus, or they may connect also to one or more auxiliary bus-bars with a different number of cells in series, feeding into each bus, thus providing two or more potentials at the centre of distribution. It will be found that when only one pressure is maintained at the centre of distribution during the time of maximum load of a large district that the pressure at the ends of the short feeders will be somewhat higher than the standard and they will be overloaded, and at the end of long feeders the pressure will be lower and the feeders underloaded, although the pressure variation at other times may be negligible. Under such conditions the storage battery becomes exceedingly valuable, for by arranging it to operate at two or more potentials, the long feeders may be connected during the time of maximum load to the auxiliary bus or buses and additional current forced over them, utilizing their full capacity and maintaining a uniform feeder end pressure by means of an investment in end cells very slight as compared with the investment in additional feeders and mains required to accomplish the same result.



PRESSURE CHARTS.

The direct-current distribution system is very much better adapted to electric elevator work than the alternating-current distribution, and, as far as I am able to learn, there has not yet been developed a commercially successful direct-coupled electric elevator capable of running at varying speeds and operated by alternating currents.

The direct-connected electric elevator is a piece of apparatus which is of the greatest value to the central station companies, since it is practically the key to the isolated plant situation, and with its aid we are enabled in a large percentage of instances to show to the owners of large mercantile establishments and buildings a decided saving in the purchasing from the central station company of electricity for lighting, elevator and general power service as compared with the cost of operating an isolated plant, using hydraulic elevators. The immense advantage to the central station companies, in being able to supply commercially successful electric elevator service economically, may be realized when we consider that there is connected to the systems of the Edison companies in New York, Boston, Brooklyn and Chicago 15,000-hp capacity in direct-connected elevators, representing a gross income of approximately $375,000 annually. At the present time alternating-current distributing systems confine us to the use of continuous running motors belted or geared to the elevator pump or winding equipment; but such an arrangement is not fitted for first-class passenger service and is very uneconomical, and similar equipments using direct-current motors were in use ten years ago, and have long since become obsolete, and have been entirely superseded by the direct-coupled electric elevator which operates for approximately one-half the cost.

The use of low tension constant potential arc lamps connected

in multiple to the distribution system has made rapid strides during the past three years, and in New York, Brooklyn, Boston, Chicago and other cities is fast superseding the use of series arc lamps wherever the low tension mains operate, and the day is not far distant when series arc lamps will be employed only in the outlying districts where there is not sufficient business to warrant the extension of the low tension distribution system. The competition effected by the Welsbach gas burner has done much to develop the constant potential arc lamp, and it is safe to say that with incandescent lighting alone the central station companies are rendered helpless against the improved gas burners; but a successful competitor has been found in the use of the 3½-ampere direct-current enclosed arc lamp, and as proof of this we have only to compare the results of the central station companies in the large cities, where these small arc lamps have been employed, with the conditions existing in the small towns, where alternating-current systems of distribution furnish incandescent lighting only. In the latter places the Welsbach light is found to be in general use and is affecting very seriously the earnings of these small central stations, owing to the lack of an alternating-current arc lamp, which would answer the purpose of the small ampere arc lamp used in connection with direct-current systems. Although very much has been done within the last year in the development of the large alternating-current arc lamp, it is still far from being in the state of perfection, and cannot be said to compare practically or economically with the constant potential direct-current enclosed arc lamp.

The use of motor cycles and electric cabs employing storage batteries is becoming more popular every day, and in London and Paris they are used very largely, in Paris an automobile club having been formed by people owning motor cycles. The central station companies using direct current will undoubtedly find a profitable outlet for their product as the motor cycle becomes more popular, and by locating charging stations for the motor cycles along the central station mains the use of the motor cycle will become more extended.

When we consider the many practical advantages inherent to the direct-current system of distribution, which adds so greatly to the commercial success of a central station company, it would seem that the original investment required to establish the plant and system should not be the only question affecting the selection of the system to be adopted.

It is universally conceded by all competent and unprejudiced engineers that the alternating-current system of distribution in a closely settled district, which shall approach in commercial value the direct-current distribution system, shall be one which has for its basis an interconnected system of secondary mains, with transformers of large capacity, and high pressure feeders from the central station to these transformers and generators in the station operated in parallel, as previously described. Therefore the cost of the distribution network in the case of the alternating-current system will not be less than that of the direct-current network, and the cost of transformers, high pressure feeders and alternating-current dynamos should be compared with the cost of low tension feeders and low tension dynamos of the same capacity, these forming the only points of comparison. The investment in each case depends merely upon the advantageous location of the central station in each individual city.

I have shown in the early portion of the paper that, in a large distribution system such as exists in Chicago, 75 per cent. of the total energy supplied to the system is delivered to the business portion of the city covering an area of 1 square mile, the stations supplying this territory being three-fifths of a mile from its electrical centre. It is therefore self-evident, since such a large portion of the energy supplied is so nearly adjacent to the desirable location of the central station, that a direct-current distribution system should form the basis of the general system of the company.

It seems to the writer that the useful field of operation for alternating-current distribution system is not in large cities, but rather in the scattered suburban residence districts and small towns where commercial lighting, elevator service and general power distribution form an insignificant portion of the demand, and where the first cost of the direct-current installation would so far exceed that of the alternating-current system of distribution with primary mains and large transformers for blocks of lighting as to make the interest charges so great that the property would be rendered unremunerative.

The successful central station company of the future will be, as outlined in my paper read before the Association of Edison Illuminating Companies, at its last convention, the one combining intelligently the use of alternating and direct currents, employing direct current in the distribution systems in the thickly settled business and residence districts of a city and alternating current for the distribution systems in the scattered residence districts and surrounding suburbs. The energy will be generated at one or two large condensing stations located where water and fuel may be obtained at the minimum cost and the energy transmitted to the various sub-stations located at the electrical centres of the distribution systems. The choice of low pressure direct current or high pressure alternating current for the transmission to the sub-stations will depend upon their relative distance from the generating stations, rotary transformers or other forms of current rectifiers being employed in the sub-stations which supply the direct-current distribution networks when alternating currents are used for the transmission.

In the discussion of this paper Mr. Ferguson stated in reply to a question that the table of the efficiency of distribution given in his paper was arrived at by taking the ratio between the pressure delivered at the customer's meter and the average station pressure for the year, which is 115 divided by 126.2 volts.* The average drop, he stated, is 11.2 volts or 8.8 per cent.

Mr. Insull, in order to make the matter plainer, stated that his company had a station in the centre of the city in Adams street, where its centre of distribution now is. The company moved 3400 feet from there, so as to have the river on one side of the station and the railway tracks on the other side, to enable it to get free water for condensing and to get coal at the minimum price. It is simply a question of balancing fuel against interest, cost and labor. The reason of the excessive drop here is because of the peculiar local conditions, so it is simply a question of spending money that way in order to save it in another way.

In closing the discussion Mr. Ferguson stated that it was only fair for him to say in the interests of the various Edison central stations that are running throughout the country that the figures which he gave in his paper do not fairly represent the average Edison central station, but are really less favorable than might be shown by the average Edison central station in regard to the question of efficiency alone.

The West Indian Cables.

About two weeks ago the cable of the French West Indies Cable Company, between Guantanamo, Cuba, and Mole St. Nicholas, Hayti, was cut by order of the commander of the American squadron now in those waters. The cable was repaired on June 21 by the Cable Company, and communication is now established practically direct between a temporary cable station at Playa del Este and New York, and thence to Washington. By reason of the fact that the American army has landed and established a base of operations on Cuban soil near Guantanamo, and that the territory so occupied is regarded as American soil, the American Government has assumed a censorship over the business going over the repaired cable. These new facilities, the establishment of which was happily timed with the landing of the invading army, will be of immense advantage to the Washington officials.

Since very active war operations will likely soon take place at Santiago and other Spanish West Indian ports, we have prepared an accurate map, showing the location of the various places that are just now figuring so prominently in the campaign. The main object of the map, however, is to show the submarine cable system of the West Indies in a manner so clear and distinct as to make it valuable for reference. In addition to the routes of the various cables, the cables of the different companies are numbered and keyed, so that the lines can be identified. The map was prepared by the Commercial Cable Company, and is accurate. The Western Union Telegraph Company, it will be seen, has four cables from Punta Rassa, Fla., to Havana, touching at Key West. These, however, are under the censorship of the American Government, The cable just repaired belongs to the French West Indies Cable Company, and runs from Santiago to Guantanamo, to Mole St. Nicholas and Cape Haytien, Hayti, and Puerto Plata, San Domingo. At the latter point the system branches off in

*This obviously shows a higher efficiency than the ratio of the watt hours delivered at the customer's meter to the watt hours sent from the switchboard, owing to the fact that the increased drop at high loads is on an increased current.—Ed.]

two directions, an overland line going to San Domingo, thence to Venezuela, under the Caribbean Sea, and a submarine cable running to Martinique, thence to Paramaribo. At Cape Haytien connection is made by the cable of the United States & Hayti Telegraph & Cable Company, which runs direct from Cape Haytien to New York. The landing place of this cable at the New York end is at Coney Island. According to the best information, Captain-General Blanco has only one cable outlet available for communication with Madrid. That is one of the cables of the West India & Panama Cable Company, between Santiago and Kingston, Jamaica. There are two cables between these points, but one of them was recently cut by the Americans.

It is stated that arrangements have been made with the Hayti Cable Company by which messages sent over the Guantanamo line from Playa del Este to Hayti will be transmitted to New York promptly, so that a message can be delivered to the Secretary of War or Secretary of the Navy at Washington within fifteen minutes. The same promptness is assured in sending dispatches in the opposite direction. At Playa del Este the most rigid censorship

MAP OF WEST INDIAN CABLE SYSTEM.

1—Direct West India Cable Company. 2—United States & Hayti Telegraph & Cable Company. 3—French West Indies Cable Company. 4—Western Union Telegraph Company. 5—Cuba Submarine Telegraph Company. 6 -West India & Panama Cable Company. 7—Commercial Cable Company.

will be exercised, but the French company will be allowed to transmit commercial messages.

Regarding the cable between Guantanamo and Cape Haytien, which touches at Mole St. Nicholas, it is stated that the office at the latter place will likely be cut out and that Government messages will be sent directly from the United States military office at Playa del Este to Cape Haytien, thus saving the time consumed in repeating dispatches at Mole St. Nicholas.

The Possible Light of the Future.

It has been estimated that about 250 times as much light might be obtained per watt than at present, if we knew how to convert it. About ten times as many watts might be obtained from the coal as are at present obtained by means of the steam engine, if we only knew how to do it. By combining both of these possible processes we may some time in the future be able to get 2500 candles with the coal now required for one candle. Besides these prospects there is a further possibility of extracting heat from even cheaper sources than coal.

Mechanical Draft.*

BY W. D. SNOW.

The substitution of the fan for the chimney as a means of draft production marks a distinct advance in the convenience and economy of steam generation. It is, therefore, fair to assume that a discussion of mechanical draft must be of particular interest to all who are concerned in central station management. Although the advantages of many improvements are to be viewed solely in their direct commercial relation, such is not the case with mechanical draft. Not only does its application insure an evident economic gain, but in both its installation and operation there are certain conveniences which are to be considered as distinct advantages, although it may be almost impossible to determine their definite economic values.

Mechanical draft may, in stationary practice, be applied in either of two ways: First, by forcing the air into a closed ashpit, and maintaining therein a pressure in excess of the atmosphere; and second, by exhausting the air and gases from the flue or uptake and thereby creating a partial vacuum, which causes a constant inward flow of air in the combustion chamber. The former is designated as "forced draft" and the latter as "induced draft." Under certain conditions a combination of the two methods may be found desirable. The natural result of the application of a centrifugal fan in either manner is to render the draft conditions positive at all times. A fan of the disc or propeller type is entirely inadequate for such work.

On the erection of a chimney the first matter to receive consideration is the foundation. This always represents a comparatively large, and in the case of unstable ground, an abnormally excessive proportion of the expense of the entire structure. A fan, on the other hand, is relatively light, requires no expensive foundation, and may in many cases be located upon the top of the boilers. Not only does this vastly reduce the cost of installation, but it furthermore lessens the space required, which is always a definite character in the case of the chimney, but with a fan placed overhead is entirely eliminated.

The portable character of a mechanical draft apparatus renders it not only valuable as an available asset, when it is no longer required in a given location, but makes possible its relocation or arrangement in a manner that is absolutely impossible in the case of a chimney, which must always stand as a monument to a departed industry or an abandoned means of draft production.

The primary duty of the chimney is to create sufficient draft, while its secondary office is to remove the gases and smoke to a proper height for discharge to the atmosphere. The height required for this purpose is almost universally less than that necessary to produce the draft. Obviously a stack of decreased height and cost will serve the purpose with mechanical draft. In fact, a sheet iron pipe extending but a few feet above the top of the boiler house will in most cases fulfil the requirements.

The steel plate construction which is common to most fans employed for producing draft makes it possible to readily design and build them to exactly suit any given conditions. Such a fan may be arranged to be driven by a belt or by a direct-connected engine, as may be desired, may be automatically controlled in its speed to meet the requirements of steam generation, and may be increased in capacity by the simple transmission of more power.

In operation mechanical draft is both positive and flexible. Its positive character renders its action independent of the weather, and its flexibility lends to it that characteristic so lacking in the chimney, the ability to exactly adapt the intensity of the draft, as well as the volume of air, to the existing requirements. How much those two elements of simple convenience mean in the generation of steam for electric traction work can only be realized by one who has experienced the sudden and immense fluctuations incident to such service. The fan is always at its best, can be instantaneously pushed to its utmost and does not have to wait for hotter fire to produce stronger draft. When properly installed, such a fan should be provided with an engine devoted solely to its driving, and the speed of this engine should be so controlled by devices that are readily applied as to increase its speed in proportion as the steam pressure falls. It is thus possible under all ordinary conditions to maintain practically constant steam pressure and to insure immediate response to sudden demands.

*A paper presented before the Northwestern Electrical Asociation, June, 1898.

Notwithstanding the immense heat losses incident to the use of a chimney, and the discharge of the waste gases at a sufficiently high temperature to create the requisite draft, the engineering public has been comparatively slow in availing itself of the advantages of some form of heat abstractor, by which at least a portion of this loss can be prevented. The reason is evident in the fact that the increased resistance thus introduced and the lower temperature of the escaping gases necessitates a chimney of considerably greater height to produce the same draft. The fan, however, lends itself most admirably to introduction under these conditions. The very factors that operate against the chimney are distinctly advantageous to the fan, if of the induced type, for the lower the temperature of the gases, the smaller the fan and the less the speed to produce the same results.

Another feature of convenience resulting from the employment of mechanical draft is to be found in the ability to burn cheap fuels which are almost invariably of small size and require an intensity of draft which is not readily created by means of a chimney. The economic value of this and the preceding features of convenience will be considered as we proceed.

The "smoke nuisance" is in many of our communities receiving the attention that it properly deserves. In practically all devices which have proved successful in the prevention of smoke, improved draft has been a most important factor and the positiveness and intensity of the draft produced by a fan have assured the success which has attended its application.

We may now turn to the distinctly economic aspects of the installation of mechanical draft, and of necessity these must be considered relatively to those incident to the use of a chimney. Employed solely as a means of creating air movement the chimney is most absurdly inefficient. It may be readily shown that under the ordinary conditions of boiler practice an engine-driven fan will move a given amount of air with the expenditure of about one-seventy-fifth as much power. This immense advantage of the fan over the chimney may be turned to good account by introducing proper devices for transferring the heat of the gases to the feed-water or to the air supplied to the fire, and the gases may, with fan draft, be cooled to a temperature far below that which could be attained with a chimney without too seriously reducing its draft. Tests of nine large boiler plants equipped with economizers and mechanical draft are reported by Roney to have shown on an average a saving of about 14 per cent. In connection with a plant of such size the steam required for the operation of the fan, with an efficient engine, can be kept within 1 per cent. of that generated by the boilers to which it is applied.

Custom and the expense of high chimneys are, doubtless, responsible for the comparatively low combustion rates which prevail in most steam plants. It may be fairly stated that to double the rate of combustion on a given grate area, it is necessary to make the chimney about three times as high, at a cost, perhaps, five times as great. In the case of a fan the same result could be obtained without even so much as doubling the cost. This clearly points to the economy to be secured by properly designing the boilers, increasing the combustion rate and securing a greater output from a given size boiler and for a stated investment. Low combustion and evaporation rates are not essential to high efficiency. Within reasonable limits the higher the rate of combustion, the less is the volume of air required per pound of coal. The fire is of necessity deeper, the draft is stronger, and each individual particle of air has increased opportunity to come in contact with the fuel. With a decreased supply of air the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces and more is taken up by the gases, which, because of less ultimate volume, move at lower velocity and thus have more time to part with their heat. As regards the economy of evaporation, F. R. Low has shown that in the case of thirty Babcock & Wilcox boilers practically as good results were obtained at a rate of 5 pounds per square foot of heating surface as at the rate of 1.75 pounds.

When a fan is employed as a means of draft production it may, at comparatively small expense, be installed of such size as to possess an emergency capacity which, if embodied in the boilers, could only be provided at vastly greater first cost, with incident larger fixed charges.

In order that a definite comparison may be made between the two methods of draft production, a certain 1600-hp plant has been taken, of which the cost is known. This consists of eight modern water-tube boilers, two economizers and a chimney 8 feet in diameter by 180 feet high. The latter is located just outside the boiler house wall. If a duplex induced mechanical draft apparatus, each fan capable of operating the entire plant, should be substituted for the chimney, it could be placed immediately above the economizers, and with its attached engine could be rigidly supported by beams resting on the economizer walls. A short stack would serve to discharge the gases above the roof.

The cost of the chimney, with damper regulator and dampers, is $9300; that of fans, engines, draft regulation and short stack, installed complete, would be about $3500, or only 38 per cent. of the draft producing apparatus for which it is substituted. That is, the saving would be $5800.

With the increased draft produced by the fans it would be possible to raise the combustion rate and the steaming capacity, or what is equivalent, the steam capacity might be maintained with a less number of boilers. Suppose one of the eight boilers be omitted from the original design, making the plant 1400 nominal horse-power, a further saving of about $4000 may thus be secured.

If the land be valuable, the reduction of space incident to the employment of mechanical draft may have an appreciable effect. If worth say $2 per square foot, the saving by omission of chimney and one boiler would be about $2000. The total saving in first cost resulting from an expenditure of $3500 for mechanical draft may thus be shown to be $11,800; that is, the saving is nearly three and a half times the expenditure necessary to secure it. Obviously there is a coincident reduction in the fixed charges for interest and taxes.

The power expenditure for operating the fans should be practically inappreciable in any well designed plant in which provision is made to utilize the exhaust steam from the fan engine.

The most direct saving in operating expense which may be secured by the introduction of mechanical draft is that resulting from the utilization of cheaper fuel. Such a plant as previously described would, under good conditions, probably, require at least 8000 tons of high-grade coal per year, operating ten hours per day. If a saving of only 25 cents per ton could be effected it would represent an aggregate of $2000 per year, a pretty good return on an investment of $3500. But in many cases much greater savings may be brought about. A case in point is that of the United States Cotton Company at Central Falls, R. I., where, with a 1000 horse-power boiler plant, the fuel originally employed chimney draft was George's Creek, Cumberland, costing $4 per ton. With forced draft, a mixture of No. 2 buckwheat screenings and Cumberland is now used, costing $2.62 per ton. The saving has been about $125 per week, enough to pay for the special steam fan in about six weeks.

Other direct and indirect advantages of mechanical draft might be presented, but the limits of the paper will not permit. If it were not for its rough and ready character, the chimney would long ago have been discarded, because of its wastefulness. In the search for the highest efficiency such waste can no longer be ignored, and when dollars and cents are concerned crude methods must give way to those of greater refinement. It is for this reason that the most progressive engineers of the present day are not only considering but adopting mechanical draft as a substitute for the chimney.

Efficiency Tests of Bichromate Cells.*

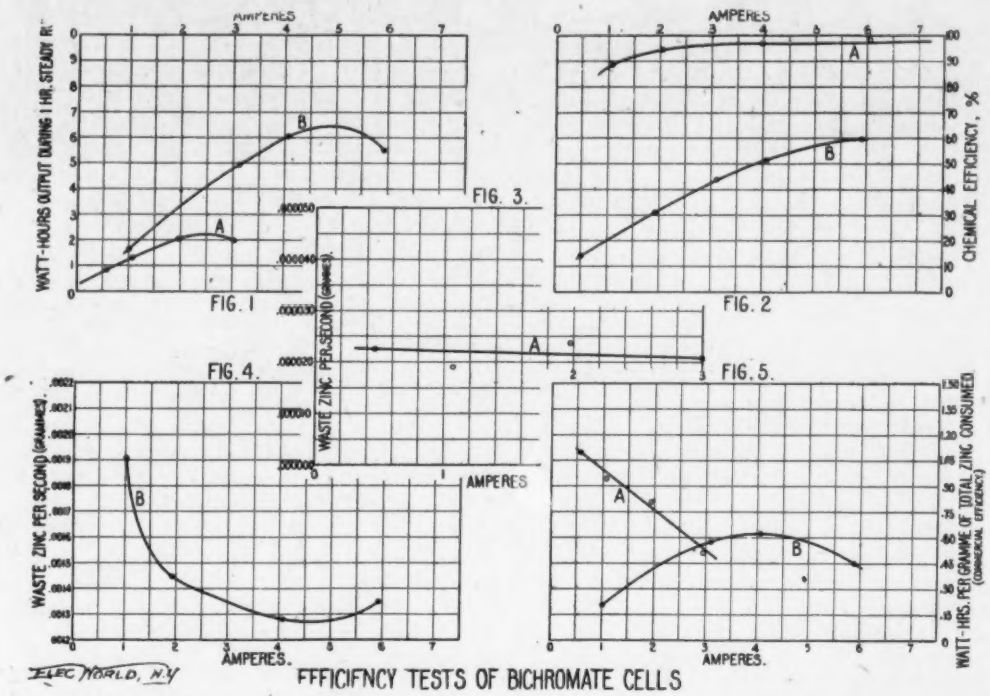
Two distinct types of cells were tested, namely, the Fuller type and the Grenet type. The exact style and dimensions of the cells which were tested are shown in Figs. 6 and 7. The heavy conical zinc of the Fuller cell was replaced by a thin zinc plate, as shown in Fig. 6, which exposed practically the same amount of surface as the conical zinc. The balances at our disposal were of insufficient capacity for weighing the heavy conical zinc.

The zinc was in every case thoroughly amalgamated and the period of each test was one hour, starting in each case with fresh solution, which consisted of 1 gram $K_2Cr_2O_7$; 1.4 grams H_2SO_4 and 8 grams water. The current was kept constant during the run, the terminal E. M. F. of the cell was observed at equal intervals of time, and the zinc plate was weighed before and after the run.

Chemical Efficiency.—The amount of zinc consumed in the proper function of the cell was in each case calculated from the known

*Abstract of Thesis in Electrical Engineering, Lehigh University, '98. Wm. Gratz and H. C. Schwecke.

value of the current, the time, and the electrochemical equivalent of zinc. This is called the useful consumption of zinc, and the ratio of useful consumption to total consumption of zinc is called the chemical efficiency of the cell. The difference between total consumption and useful consumption is called waste zinc. The chemical efficiency approaches 100 per cent. for very large currents, partly because the useful consumption increases and partly because the waste consumption, due to local action, actually decreases, as shown in Figs. 2, 3 and 4.



EFFICIENCY TESTS OF BICHROMATE CELLS

The commercial efficiency is in the watt-hours delivered to the external circuit per gram of zinc consumed (total). Fig. 5 shows that the Fuller cell has its maximum commercial efficiency for a current less than half an ampere, while the Grenet cell gave its maximum commercial efficiency for a current of about four amperes. Fig. 1 shows watt-hours output for various currents. The Fuller cell delivered a maximum of work to the external circuit for a current of about 2½ amperes and the Grenet cell delivered maximum work for a current of about 5 amperes.

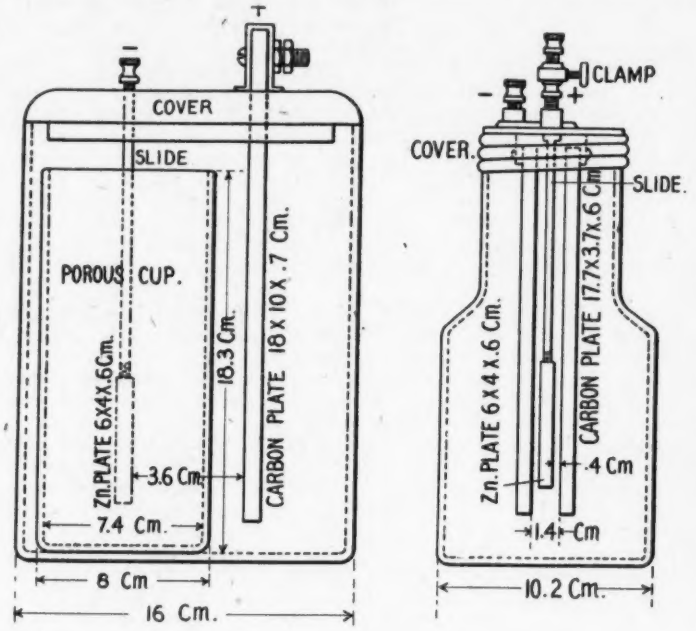


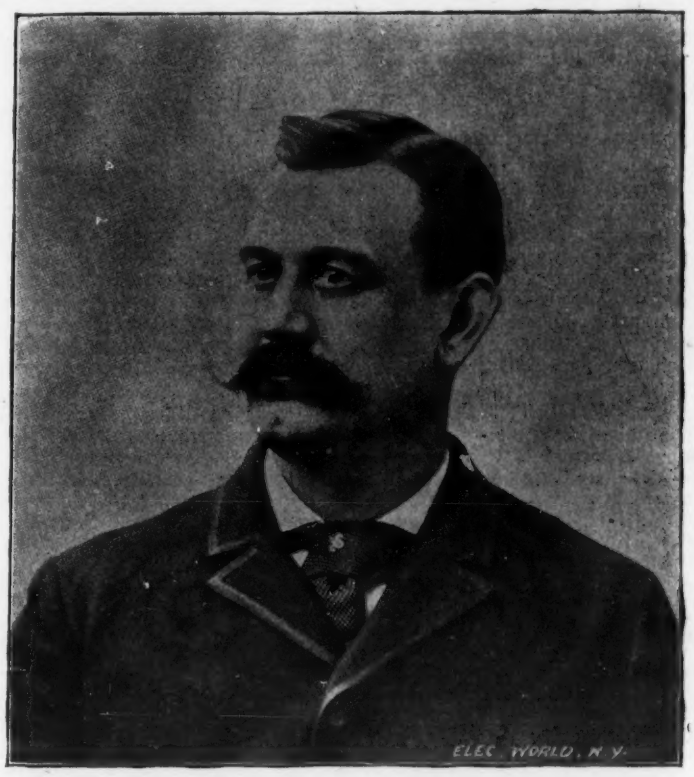
FIG. 6. FIG. 7.

EFFICIENCY TESTS OF BICHROMATE CELLS.

The Convention of the Independent Telephone Association.

During the present week (June 30, July 1 and July 2) the Independent Telephone Association of the United States will hold its second annual meeting at the Palmer House, in Chicago. The announcement of the meeting simply states that it will be a "business meeting," and that anyone interested in independent telephony may join as members. Judging from the character of the association and its objects as laid down in its constitution, there will no doubt be plenty of "business" to which the meeting will be called upon to give its attention.

The association was organized in Detroit on June 22 and 23 last year, ninety-nine independent exchanges and twenty-one manufacturing concerns being represented. A constitution was adopted.*



JUDGE JAMES M. THOMAS, PRESIDENT OF THE INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.

The objects of association as set forth in this instrument are: 1, the protection of all independent telephone interests of common concern to the members of the association; 2, the protection of subscribers to telephone apparatus operated by members of this association; 3, the bringing about a reasonable charge for tolls and the rental of telephones, so that the telephone may be within the reach of the masses of people; and, 4, the bringing about a complete system of inter-municipal communication and long-distance trunk lines.

*See page 847 of THE ELECTRICAL WORLD June 26, 1897.

DIGEST
OF CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN

By Carl Hering.

Dynamos, Motors and Transformers.

STARTING AND REGULATING MOTORS. Menges. "L'Eclairage Elec.," June 5.—An illustrated description of his method as compared with those of Mueller, Fischer-Hinnen, Cutler and Egger, all of which, including the present one, have already been noticed in the "Digest," for most of which, however, the references were to German journals.

CALCULATING THE EFFICIENCY OF TRANSFORMERS. Aliamet. "L'Elec.," June 11.—Knowing the several losses in a transformer for a given charge, the efficiency at that load, as well as at other loads, can be calculated by the well-known formula, which, however, is rather complicated. He describes the simplification of this formula suggested by Johannesen.

CLAMPING COMMUTATOR SEGMENTS.—Lond. "Elec. Eng.," June 3.—Descriptions of methods for clamping and chucking them, before boring.

Lights and Lighting.

LOCOMOTIVE HEADLIGHTS.—"Eng. News," June 16.—A well illustrated description of the Pyle electric headlight, which, after numerous experiments, is in use on more than 200 locomotives. The engineer can see obstacles half a mile distant, and owing to the reflection in the sky and on the clouds, the light can be seen for a distance of 10 miles in a level country and 3 or 4 miles in a rough country; these headlights are now classed as a safety appliance. An objection was raised to the fact that it would be difficult for the engineer to distinguish the different colors of the signal lamps, but experiments have shown that red lights show even more distinctly and that there is no diminution in the brilliancy of green or white lights. The small dynamo, developing 25 amperes at 40 volts, is driven by a direct connected steam turbine, the whole apparatus weighing only 250 pounds; the dynamo also supplies current for incandescent gauge lamps in the cab; the arc light has an intensity of 4000 cp.

Power.

STEAM USING PLANT. Jeckell. Lond. "Elec. Eng.," June 10.—A reprint of a long Municipal Electrical Association paper, with the discussion.

YUBA-MARYSVILLE TRANSMISSION.—"Jour. of Elty," May.—A very long, well illustrated description of this plant. The distance of transmission is 12.5 miles to Marysville and 7.25 to Brown's Valley; there are three two-phase generators of 360 kw each, directly driven by Pelton water wheels; the frequency is 8000 per minute, and the voltage is 1200 or 2400, which is transformed up to 16,700 for transmission; the flume is nearly 8 miles long, and the canal 23 miles. All the engineering data is given in a condensed form.

30,000-VOLT TRANSMISSION.—"Jour. of El'ty," May.—Descriptions of some tests made with the Yuba plant, described above. Some experiments were made with 30,000 volts on the line; when the wires were not more than 2.75 inches apart the arc would jump across and travel, but after changing the distance to 18 inches there was no further trouble; under these conditions the charging current of the line was 2.25 amperes; the drop in voltage was 250, of which 95 (probably 65 is meant) could be accounted for by resistance, the remaining 185 being chargeable to line inductance and capacity. The Martin high potential switch was thrown open when the voltage was 30,000 (but what the current was at the time is not stated); there was no burning of contacts of the 3-foot arc, showing that the switch could be used for such circuits; no static discharges or illuminations of the line were noticed at these voltages. The experiments are said to have demonstrated conclusively the practicability of using voltages much higher than are at present in use.

POWER OF LOWER NIAGARA. Dunlap. "West. Elec.," June 18.—A brief description, with a map, of the proposed utilization of the power of Niagara River below the Falls; there are four or five places on the Canadian side at which it would be feasible to take advantage of the shore levels to develop the potential power plants.

POWER HOUSE AT NIAGARA.—"Sc. Am.," June 18.—A brief, illustrated description of the plant of the Hydraulic Power and Manufacturing Company, the water for which is supplied by the canal.

Traction.

DESIGN OF RAILWAY MOTORS.—Lond. "Elec.," June 10.—An abstract of the discussion of Carus-Wilson's paper (see "Digest," June 18). Taylor called attention to a recent American paper by Short, in which are pointed out the advantages of continuing the initial acceleration through a greater range than was at present done; the question raised about the point on Carus-Wilson's curve, where the acceleration ceased to be uniform, was an important one; Taylor's remarks are explained more fully in a communication to that journal and the Lond. "Elec. Rev." Smith endorsed the American method of rating motors by their force-power as distinguished from their horse-power; the calculations in the paper were based on the assumption of a constant train resistance; while the internal train resistance is approximately constant the external resistance is not so; even the internal resistance varies greatly at the first moment of starting; the calculations are for covering a certain distance in a certain time, but there is another point of value, and that is how to get the work done as quickly as possible with a minimum stress on the machinery, and on this basis he thinks that it would be found that uniform acceleration up to the point at which retardation began was the best law to follow, and that this should be followed by a uniform retardation. Ayrton also favored the American system of rating motors; he called attention to a number of errors and inaccuracies in the paper; he thought one consideration had been ignored, namely, the fact that the train was not going on forever, but that it was going to stop, and the calculations should be made for going from one stopping place to the next in the minimum time; an interesting result arrived at was that by rightly proportioning the air gaps and the velocity ratio results could be obtained approaching very nearly to the greatest possible economy. Grove complained that the paper was full of assumptions, some of which he thought must be wrong. In his reply Carus-Wilson said among other things that as the distance increases the series-parallel control becomes of less advantage; he disagrees with Short on the subject of constant acceleration; while Short made a quicker start by a few seconds, the consumption of energy is much greater than with the ordinary control.

DESIGN OF RAILWAY MOTORS. Carus-Wilson. Lond. "Elec.," June 10.—A brief reply to the recent criticisms in that journal (see "Digest" last week). He did not consider the motor only at rest, but showed also how the conditions of motion may be stated in terms of the force unit; the assumption that the acceleration is to be constant up to full speed was made only with the object of leading on to a case of varying acceleration, and the most important conclusions related to the advantages gained by varying acceleration. The principal obstacles to carrying out the design according to the theory are the limited clearance and weight of the motor.

ELECTRIC CARS ON STEAM RAILROADS.—Lond. "Elec. Eng.," June 3; abstracted from "Moniteur Industriel."—The Northern Railroad of France is about to introduce electric motor cars to supplement its suburban traffic. These cars are to be used on trains traveling a longer distance and will avoid frequent stoppages, as the electric car will be uncoupled at the stopping place, from which it will proceed by itself to the minor stations, leaving the train free from the delays due to stopping at unimportant places. The power for the motor cars will be supplied by accumulators; the total weight of the car is 15,540 kg, the accumulators weighing 4800 kg; trials have shown that a pull of 0.80 per ampere is obtained at the circumference of the wheel. The 50 passenger cars weigh 24,000 kg, of which the accumulators weigh 5500 kg.

MONTMORENCY.—"L'Energie Elec.," June 1.—A long, illustrated description of this line near Paris.

STOCKHOLM. Dahlander. "Elek. Zeit.," June 9.—A brief illustrated description of a suburban line about 7 miles long. The gauge is less than one meter, and the grades up to 4.8 per cent. are quite great; a train carries 150 passengers at a speed of 40 km per hour, thus requiring 120 to 140 horse-power. The conditions involved a number of difficulties, one of which was the arcing at the sliding contact; the trolley wheel is replaced by the contact bar; a battery of accumulators is used to equalize the current. The total weight of the new motor car is 20.5 tons; triple reduction gearing is used, the gearless motors on the first car having been abandoned; there are four motors to the car, each having four poles, only two of which are wound; some illustrations of the motor and the car are given; the two motors on the same track are always connected in parallel; when two motor cars are coupled they are connected with a cable containing nine wires, so that both are operated from the same controller.

MOTOR WAGON TRIALS AT LIVERPOOL.—"Eng. News," June 16.—A brief account from Lond. "Engineering" and "Engineer" of the recent competition of motor vehicles adapted to heavy haulage.

WIRING CARS FOR DECORATIVE LIGHTING. Harding. "St. Ry. Rev.," June 15.—An illustrated description of the method used by a Chicago line, by means of which the wiring may be quickly put in place or removed.

ELECTRIC LOCOMOTIVES.—"Eng. News," June 16.—The following table compares the general features of the B. & O., the London Central and the Hoboken Shore Line, electric locomotives:

	London Central.	Balt. & Ohio R. R. } Heavy freight } and passenger.	Hoboken. Shore R. R. switching.
Service	Rapid transit.		
Length	30 feet 0 inches	35 feet 0 inches	29 feet 0 inches
Width	7 " 8 "	9 " 6¼ "	8 " 0 "
Height	9 " 4½ "	14 " 3 "	13 " 0 "
Wheel base, rigid	5 " 8 "	6 " 10 "	5 " 6 "
" total	20 " 4 "	6 " 10 "	18 " 2 "
Wheels, diameter	3 " 6 "	5 " 2 "	3 " 3 "
Motors, number	4	4	4
" H. P. total	800	1,280	540
Speed,* miles per hour	27	12 to 30	8
Weight, pounds	84,000	192,000	57,000
Hauled, tons	105	1,200 to 1,900	295

* With load.

Installations, Systems and Appliances.

SINGLE VS. MULTIPLE GENERATING STATIONS. Snell. Lond. "Elec. Rev.," June 10.—A reprint of his short Municipal Electrical Association paper. It is also briefly discussed and criticised editorially. He discusses the question of supplying a district from one or from several generating stations, and favors the latter; when only one station is used it would in most cases be located in the outskirts of the city. As to the limit of the power for one station, he quotes the opinion of Kennedy, expressed several years ago, that the critical limit lies somewhere between 3000 and 5000 horse-power; he appears to agree with this. He thinks the ideal to be aimed at is the direct current system, with its simplicity and the possibility of storage; he considers it unnecessary to build stations outside of a town; the capital cost favors the location directly on the so-called centre of gravity of the system; the lower the pressure adopted, consistent with economy, the safer and more reliable the supply; multiple stations with simple radiating feeders appear to provide the simplest system obtainable; multiple stations are not any more expensive to construct than single stations, and he cites the London companies as examples; the load factor scarcely enters into the argument, as it may even be better for multiple stations than for one distant one; the question of the nuisances are also discussed. In making extensions, therefore, the most natural method is to prospect new areas with high current direct current from sub-stations, so designed that ultimately they may become part of the general network into which the second or other stations will ultimately feed, these taking the place of the temporary substations.

SWITCHBOARD APPARATUS. Blaikie. Lond. "Elec." and "Elec. Rev.," June 10; briefly abstracted in the "Elec. Rev." A reprint of a long Municipal Electrical Association paper. It is of a practical character, giving many hints regarding the construction of switchboards. He claims that the essential characteristics in the design of a board are, that the operator is not in danger, that no arc shall be maintained, that the contacts shall not be burned or injured, and that no heating shall occur at the contacts; the paper does not admit of being abstracted briefly. Among other things he suggests a list of lengths of breaks for various voltages and currents; he suggests the use of a paint which changes color on heating, on contacts which have to carry large currents; copper fuses on the switchboard seem to be recommended. Ammeters, voltmeters, rheostats, switches and synchronizing apparatus are each discussed separately, as is also the general arrangement of the board; he urges standardization of switchboards and seems to favor the American method of unit panels. The discussion is published in the Lond. "Elec. Eng."

MANAGEMENT BY LOCAL AUTHORITIES. Hesford. Lond. "Elec. Rev." and "Elec. Eng.," June 10.—A reprint of a Municipal Electrical Association paper; the discussion is given in the latter journal; some comments of a partially unfavorable nature are given editorially in the Lond. "Elec. Rev." He favors the operation of central stations by municipalities. He urges the cheapening and perfecting of the means of distribution, claiming that the electric light will be popularized when more attention is given to this subject instead of to the improvement of steam engines and boilers; most failures have occurred in the distributing plant as distinguished from the boilers and engines.

ECONOMY IN CENTRAL STATION MANAGEMENT. Summerfield. Lond. "Elec. Eng.," June 3.—A short article pointing out directions in which economy should be exercised. He refers almost exclusively to the steam generating plant.

LEGISLATIVE CONTROL.—Lond. "Elec.," June 10.—A reprint of the report of the committee of both Houses of Parliament concerning the law of electric generating stations and supply business; it is also discussed editorially.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," June 10.—An analysis of the accounts of the Hammersmith station.

MUNICIPAL ELECTRICAL ASSOCIATION.—Lond. "Elec. Eng.," June 10.—A report of the proceedings of the third annual meeting, together with reprints of the papers, which are noticed in the "Digest" under special headings. Portraits of the president and council are given in a supplement, accompanied by brief biographical sketches. The presidential address by Gibbings is reprinted, and deals chiefly with the work of the association, giving in conclusion some suggestions on the subject of standardization of the plant. A brief account of the proceedings is published in the Lond. "Elec. Rev." The presidential address is also published in Lond. "Lightning," June 9.

SWITCHBOARD. Rosebrugh. "Can. Elec. News," June.—An illustrated description of the switchboard in the laboratory of a school in Toronto.

Wires, Wiring and Conduits.

INSULATION RESISTANCE OF LEAKAGE CURRENTS. Russell. Lond. "Elec.," June 10.—He calls attention to the importance, in the risk of fire, in knowing what power is being expended along the various leakage paths in watts; as leakage takes place along many paths, it is not possible to find the individual leakage path, but it is possible to find what is the maximum possible leakage current, and this he considers the proper object of tests on the wiring of a building; it is the leakage in watts and not the insulation resistance which should be found. The danger to fires depends on the volts, and with the same insulation resistance it is proportional to the square of the voltage; thus the insulation resistance of a 200-volt circuit should be four times that of a 100-volt circuit. He then shows how the leakage watts in a two-wire installation may be calculated from simple measurements of the insulation resistance between each wire and the ground; there may also be a leakage directly from one main to the other, which does not pass through the ground; the resistance should be measured of one main when the other is grounded; the same for the other main; and finally the resistance between the mains which is in parallel to the two other leakage currents in series; the test is first made with the switches turned off, with all the lamps in position, and second, with the switches on and all the lamps out of their sockets; the leakage watts are then equal to the square of the voltages divided by these resistances. In every day practice generally only the insulation resistance of the wiring to earth and that between the two mains are measured, and there is no great objection to this for a two-wire system, but in a three-wire system this method of fixing a maximum value to the leakage current to earth fails; he then discusses with the aid of simple mathematics how the leakage watts in a three-wire installation may be determined; he divides the leakage losses into six, and for a given total leakage the danger to fire would be a minimum when these six values are nearly equal. He then discusses the leakage currents in a three-wire distribution network, and shows how the maximum value of the leakage watts may be determined. The insulation rule is discussed and the inconsistency is shown in that the resistance should be doubled instead of being made four-fold, when the voltage is doubled; the rules which consider leakage currents are more instructive than those which consider insulation resistance; he thinks it will be better to state the maximum watts which it is permissible to waste between the mains themselves and the earth; he suggests that the leakage watts from either main to the earth or from one main to the other should not be greater than the thirty-thousandths part of the maximum watts supplied to the installation. Regarding the distinction between leakage for direct and alternating currents he believes that most electricians will agree that the leakage watts allowable in the two cases ought to be the same for the same power supplied.

MOST ECONOMICAL CROSS-SECTION OF TRANSMISSION CIRCUIT. Bull. "Elek. Zeit.," June 9.—A mathematical article in which he develops a formula based on the well-known Lord Kelvin law, but reduced to a comparatively simple form; one of them gives the loss and the other the cross-section. These are based on an equation for the price of a kw-hour in a secondary circuit, on expressions for the factors in this which depend on the cross-section, and lastly on the finding of the conditions under which the price per kw hour in the secondary circuit becomes a minimum. Such factors as the frequency and the phase shifting are also included. The final formulas appear relatively simple, but cannot be reproduced here without enumerating the numerous factors which have been introduced.

MUNICIPAL OWNERSHIP OF WIRES.—"Eng. News," June 16.—A note stating that according to a recent ordinance the city of Baltimore will build, own and operate subways for electric wires, and that the overhead wires will therefore be removed. An electrical commission is provided for, which is empowered to construct the subways and to compel overhead wires to be taken down; those using the subway must give a bond at the rate of $100 per mile of duct; a sum of $1,000,000 is provided for this work.

Electro-Physics and Magnetism.

COHERERS. Pasquini. "Nuovo Cimento," March; abstracted briefly in Lond. "Elec.," June 10.—A study of the properties of various types of coherers. He concludes that they must have a certain freedom of motion among their particles; the latter should be large rather than small; mixtures of two metals are more sensitive than of a single metal; the change of resistance is greater when in a circuit than when insulated; "the wires have indeed a great deal to do with the disturbance;" even when the coherer is insulated some wire appendages will considerably increase its sensitiveness; a coherer will not re-act if enclosed within a metal case, but a very small opening in the case allows the waves to produce an effect.

PASSAGE OF ELECTRIC WAVES FROM ONE CONDUCTOR TO ANOTHER. Gutton. "L'Eclairage Elec.," June 4.—A reprint of an Academy note.

RETARDATION OF SPARK DISCHARGES. Wesendonck. Wied. Ann.," No. 5; abstracted briefly in the Lond. "Elec.," June

10.—He measured the potential at which the discharge from a gilt needle point begins in hydrogen. He found that the negative discharge potentials in hydrogen lie between 1350 and 1500 volts, and the positive between 1450 and 1500; no amount of retardation appears to make much difference; a very small deposition of mercury on the needle, however, raises the discharge to 2000 volts.

DOUBLE ELECTRIC REFRACTION. Pasquini. "Nuovo Cimento," March; abstracted briefly in the Lond. "Elec.," June 10.—Descriptions of experiments with waves of about 1 cm in length, the substances including a number of minerals.

RE-GENERATING X-RAY TUBES. Graves. Lond. "Elec. Rev.," June 10; abstracted briefly from the "American X-Ray Journal," April.—Dead tubes may be resuscitated by reversal, separate gaps and tin foil on the cathode end of the tube. In tubes of ordinary resistance the direct resistance is about three times the reversed and when the current refuses to pass in the proper direction it can probably be passed in the reverse direction; but if this is impossible then success will usually be attained by introducing a spark gap between the tube and the negative terminal of the generator; a spark gap at the negative pole reduces the resistance, while at the positive pole it increases it; tubes that have been thus resuscitated are far more efficient than new tubes which have not yet become dead.

CATHODE RAY HYPOTHESIS. Villard. Lond. "Elec.," June 10; abstracted briefly from "Comptes Rendus," May 31.—He describes experiments made to prove that cathode rays, the cathode stream, and the so-called canal or Goldstein rays have a reducing action. The oxidized surface of a sheet of copper was reduced by the cathode rays. On the strength of these experiments he advances the hypothesis that hydrogen has exclusively the property of furnishing cathode rays.

MECHANICAL CONCEPTION OF CURRENTS. Weyde. "Elek. Zeit.," June 9.—The first part of an illustrated article describing what he calls the mechanism or mechanical conception of the production of a current from a galvanic cell, based on the conception of whirling ether particles.

ALTERNATING CURRENT WATTS.—Lond. "Elec. Eng.," June 10.—Answers to a request for examples in which there is a wide difference between the true watts expended and the product of the volts and the amperes.

EFFECTS OF PROLONGED HEATING ON MAGNETIC PROPERTIES OF IRON. Roget. Lond. "Elec.," June 3.—A reprint of a Royal Society paper. When transformers are in use their open circuit loss is liable to increase considerably with time, implying a deterioration in regard to hysteresis; this was shown some years ago to be a direct effect of prolonged heating; in the present paper he describes his investigations in this direction with a more extended range of temperature than was used by Mordey and Parshall. The hysteresis was measured with Ewing's tester, and the specimens were all cut from the same sheet of soft Swedish transformer plate; the tests were all made at atmospheric temperature after various periods of prolonged heating at various temperatures. The effects of the heating were always completely removed by re-annealing, so that the same specimens could be used over again. The effects produced by baking differed widely at different temperatures; below 40° C. there was no evidence of any change; between 40 and 135° C. the hysteresis simply increased with time, being rapid at first and then slower; the results are given in curves and tables; from about 135° C. upward a maximum hysteresis value was reached in a comparatively short time, after which there was a marked decrease; for higher temperatures the initial rise is very rapid, the hysteresis doubling in a few hours at 160°, and reaches nearly three times its initial value in a few days; after seven days it began to decrease, and in fifteen days it fell to 2.5 times its original value; a still more notable decrease occurs at higher temperatures; in the neighborhood of 180° the maximum increase seems to be greatest, for at higher temperatures the hysteresis, although rising more rapidly at first, does not reach so high a maximum and begins to fall sooner and faster, tending to a lower state; the peak at which the hysteresis reaches its maximum comes sooner the higher the temperature, and its height becomes reduced when the temperature is high. Experiments were made to see whether the iron took up anything from the atmosphere, but no difference between the iron heated in vacuo or in heated air could be found; there is nothing to show that when baked iron is left for a long time it recovers from the condition produced by baking, although the original condition is always restored by re-annealing. Some later experiments which are briefly mentioned describes some permeability curves for a ring of the same material before and after baking, and this shows that the saturation value of the induction is unchanged by prolonged heating; although the earlier part of the curve was much altered, those above a force of 15 units are practically indistinguishable. His experiments are still in progress.

ENERGY LOST IN MAGNETIZATION. Maurain. "L'Eclairage Elec.," June 4.—It is important to know whether the energy lost in a magnetic cycle depends on the rapidity of this cycle; he reviews the various tests made by others to determine this; in most of these a comparison was made between the static and the dynamic cycle. He then describes his own experiments, in which he compared only the dynamic cycles corresponding to different rapidities of variations; he used a modified Hopkinson method. All calorimetric methods have led to the result that the energy dissipated in a rapid cycle would be less than that dissipated in a slow cycle, but the calorimetric method seems to involve an error. His own results are that the total energy diminishes when the frequency increases, for the most compact cores and it is independent of the frequency for the most subdivided cores. In the latter the effect of the induced currents becomes almost zero, and the energy lost then represents that lost by magnetization alone, which experiments show is independent of the frequency. In conclusion he refers briefly to the retardation of the flux of induction in the field; he found that the retardation in the time is greater as the core is more compact.

PENETRATION OF MAGNETISM. Kirstaedter. "Wied. Ann.," No. 5; abstracted briefly in the Lond. "Elec.," June 10.—Early experiments with iron rods contained in a cylinder of iron showed that the magnetization does not penetrate below a certain depth, that is, that there is a screening action; this has been a subject of much controversy; the present author, therefore, made experiments with iron rings, which have no sensible magnetic dispersion; split, hollow rings of various thicknesses were used. The results showed a residual difference in the cubical magnetization, which is, however, due to disturbances produced by Foucault currents; with a thinner ring just fitting the hollow one, the magnetizations of both were found to be equal to the sum of their separate magnetizations, within 1 per cent.; this argues against a screening action, and is in accordance with Kirchhoff's theory of magnetization.

MAGNETIC SCREENING. Stefanini. "Nuovo Cimento," March; abstracted briefly in the Lond. "Elec.," June 10.—Similar researches to those described in the abstract above (Kirstaedter's paper), but differing in that the rings were built up of several hanks of iron wire; the outer acquired the same specific magnetization as the inner; further tests also showed that there was no magnetic screening.

MAGNETIZING BY MEANS OF LIGHT.—Lond. "Elec. Rev.," June 10.—A brief communication by Charles to the London "Engineer," calling attention to a passage in the British Cyclopedia, published in 1835. It describes an experiment by Morichini in which he concentrates the violet rays from a solar spectrum, by means of a convex lens, on to a steel needle, moving the lens parallel to the needle, so that the focus passed from the middle of one extremity of the needle to the other and always in the same direction, without touching the other half; by continuing this for nearly an hour the needle was found to be "completely" magnetized.

DISCHARGE BY X-RAYS. Child. "Phys. Rev.," May-June.—A long article describing experiments with the fall of potential at the surface of a metal when exposed to the discharging action of X-rays. The results are given in curves and tables, and show the following: That there is a large fall of potential at the surface of the metal when the discharge is caused by X-rays; that this fall is diminished by allowing the rays to strike the plate; that it is diminished to the greatest extent in the case of metals which absorb X-rays most.

SURFACE TENSION. Barnett. "Phys. Rev.," May-June.—A long article describing investigations concerning the surface tension of liquids under the influence of electrostatic induction; he adopted a method in which both electrolytic action and electrostatic disturbances are excluded; he used the method of ripples in its latest form. The results are in accord with the theory of Helmholtz.

Electro-Chemistry and Batteries.

QUANTITATIVE SEPARATION OF CHLORINE, BROMIUM AND IODINE. Specketer. "Zeit. f. Elektrochemie," June 5.—A reprint of a short paper read before the German Electrochemical Society. He describes the application of a method of separating these halogens by electrolysis at various definite voltages; iodine should separate from chlorine and bromium at voltages below 0.94, while bromium should separate from chlorine slightly below 1.31 volts. To try and separate them in a free state was abandoned, and in the method described he used their combinations with silver; this gave results which are perhaps as good as those obtained by the new chemical methods, but the method has its limits, at least for separating chlorine and bromium. The oxidation of the air must be carefully excluded, the source of current must be a constant one and the concentration of the acid must be kept a certain amount.

ELECTROMOTIVE FORCE AND CHEMICAL EQUILIBRIUM. Bredig. "Zeit. f. Elektrochemie," June 5.—A reprint of a short paper read before the German Electrochemical Society; it is theoretical in nature, showing the proof of the equation through the researches of Knuepffer.

ACCUMULATORS. Gebhard. "Zeit. fuer Elek.," May 29, and June 5.—A reprint of a long paper of a general character on the Tudor accumulator made by his company. He points out the advantages of a large surface on the positive plates, with small depth of active material. Train lighting is briefly discussed; great stress is laid on the proper attendance of an accumulator plant; it appears that in a number of their installations the makers provide the attendant. The paper contains practically no data. He claims that a traction cell is used ten times as much as one in a stationary plant; in a 30-hour discharge the voltage falls only 3 per cent., or with one period of rest, 2 volts. Theoretically 4.5 grams of the active material should give one ampere-hour, or one kw 220 ampere hours, but in practice only 80 are obtained, and this only at very slow discharges; at a three-hour discharge only 40 ampere hours are obtained from the positive plate.

OXIDATION AND REDUCTION OF COMPLEX SALTS. Peters. "Zeit. f. Elektrochemie," June 5.—A reprint of a paper of a theoretical nature read before the German Electrochemical Society, on the part taken by complex salts in the oxidation and reduction chain in connection with Ostwald's theory.

PROGRESS IN ELECTROMETALLURGY IN 1897. Andreoli. "Eng. and Min. Jour.," June 18.—An article summarizing the progress of the various electro-metallurgical processes during the past year.

Units, Measurements and Instruments.

METHOD OF MEASURING POLARIZATION. Heim. "Zeit. f. Elektrochemie," June 5.—A long paper read before the German Electrochemical Society, giving details and results of measurements of a method which consists in measuring the voltage between two parallel plates at a certain current density, and then measuring it again with the same current density when a middle electrode is inserted in the cell, dividing it into two parts; the voltage measured in the first case is equal to that of polarization plus that lost in the resistance, while in the second case it is equal to twice the polarization voltage plus the same voltage lost in the resistance; the second voltage less the first will therefore give directly the E. M. F. of polarization for that particular current density. It is assured in this that the introduction of the middle plate does not alter the internal resistance, and in that case this factor need not be considered; the method, therefore, affords a means of measuring the polarization with a continuous current by measuring simply two voltages and a current; in a short time many measurements could be made for different current densities, being careful only that the temperature is kept constant; if the currents are carried to nearly zero, then, by extending the curve graphically, the value for the decomposition polarization may be obtained. From the same two measurements at the same current, the internal resistance can also be calculated, as it will be equal to the difference between the two voltages divided by the current; this should be done to control the tests, and will show whether the middle electrode fitted the vessel tightly; if it does not, the results will not be accurate, and this seems to be the difficulty in the process. After trying to make the joint watertight he abandoned it and instead passed the plate through deep, narrow grooves in the sides and bottom of the vessel, so that the stray current which leaked around the edge was only an insignificant amount and can be calculated.

WESTERN STANDARD CELL. Cohen. "Zeit. f. Elektrochemie," June 5.—A short paper read before the German Electrochemical Society. According to the researches of Jaeger and Wachsmuth, there is a sudden change in the temperature coefficient at about 15°, due to a certain change in the concentration of the cadmium sulphate. The conclusions of the present author are that the cell should never be used below 15° C.; if it has been subjected to a lower temperature it should before being used be heated for a half hour above 15° C., after which a rest of 1.5 to 2 hours should be given the cell before the tests are made.

PREPAYMENT METERS.—Lond. "Elec. Rev.," June 10.—An illustrated description of the application of Bastian's device to the Thomson wattmeter. This is a prepayment device, which may be attached to any of the well-known types of meters; the coin passed through the slot forms a rigid connection between the needle and the mechanism and a turn of the handle switches on the current; the more coins that are dropped in up to a certain limit, the farther will one pointer be separated from the second, and the longer they will be in coming together again.

ELECTROLYTIC METER FOR ALTERNATING CURRENTS.—Lond. "Elec.," June 10.—A note stating that Bastian has recently succeeded in adapting his electrolytic meter (see "Digest," June 11,) to alternating currents. This he does by placing the meter in one branch of a divided circuit in each of the two branches of which there is a cell with an aluminum electrode; each branch, therefore, allows the passage of a current in one direction only; the meter is in only one of these branches.

ARON METER.—"L'Eclairage Elec.," June 4.—A brief discussion from the German patent.

PHASE METER. Tuma. "Science Abstracts," May.—A brief abstract of the article noticed in the "Digest" January 29.

LOW TEMPERATURE READINGS. Dickson. "Phil. Mag.," June.—A table based on his empirical formula, giving the reduction to normal air temperatures of the platinum temperatures in the low temperature researches of Dewar and Fleming.

PORTABLE TESTING SET FOR INSULATION MEASUREMENTS.—Lond. "Elec. Eng.," June 10.—Illustrated descriptions of the Silvertown, the Muirhead and the Evershed portable testing sets for measuring the insulation resistance of dynamos, cables, etc.

MEASURING STRESS IN IRON AND STEEL. Turner. "L'Eclairage Elec.," June 4; abstracted from the "Iron Age."—A metal wire becomes cool when it is stretched, and this change in temperature may be noticed by means of a thermo-electric couple. He shows that this method may be used to study the stresses in iron and steel constructions, as, for instance, in those of complicated shapes.

MEASURING LIGHT FROM PROJECTORS. Blondel and Rey. "Elek. Zeit.," June 9.—A German translation, with the illustrations, of the article noticed in the "Digest" March 19.

DETERMINING THE PERIOD OF OSCILLATIONS. Webster. "Phys. Rev.," May-June.—An investigation of an experimental determination of the period of electrical oscillations of alternating currents when a charged condenser is discharged through a circuit containing self-induction; the apparatus and methods are described. This investigation was awarded the Elihu Thomson prize.

Telegraphy, Telephony and Signals.

DEVELOPMENT OF TELEPHONY IN GERMANY.—"Elek. Zeit.," June 9.—A long article giving tabular data and other information, including a map showing all the interurban lines. It is accompanied by a brief editorial notice. The date of the statistics is 1897; the number of telephone central stations is 632, an increase of 37 per cent., as compared with the year 1894; the number of subscribers 164,681, an increase of 48 per cent.; the length of lines, 240,127 km, an increase of 77 per cent.; the number of daily communications 1,440,657, an increase of 34 per cent.; the length of interurban lines, 90,512 km, an increase of 86 per cent.; the number of daily interurban communications 191,884, an increase of 48 per cent. As a mean for the whole German Empire there is one subscriber or public station for every 318 inhabitants; the number of connecting circuits is 2,100, and with few exceptions all the stations are connected together; the average length of line for a subscriber is 1,462 km; Berlin contains most subscribers, the number being 36,650, after which comes Hamburg, 13,561, followed by Dresden, Munich, Leipsic and Frankfort between 5000 and 6000; 19 cities have between 1,000 and 5,000 subscribers; 141 between 100 and 1000, and the remaining 466 have less than 100; in Frankfort o. M. there is one subscriber to every 45 inhabitants, in Berlin and Hamburg 46, Stuttgart 49, Dresden 59, Munich 68, and Leipsic 76. The map referred to is the first one of the kind ever published.

CUTTING CABLES.—Lond. "Elec. Rev.," June 10.—Some remarks by Bright in the London "Times." Referring to the recent discussion in that paper, he points out the necessity of a system of cables connecting the entire British Empire by direct and independent means without touching on foreign soil; in the event of a permanent and reliable understanding being arrived at with the United States, that country would not require to be regarded as foreign territory; a further alliance with Japan is also suggested. In another communication by Holland he quotes from the conclusions arrived at at a certain meeting in Brussels in 1879.

LIGHTNING ARRESTER FOR TELEGRAPH CIRCUITS.—"Elek. Zeit.," June 9.—An illustrated description of a device used on one of the railroad telegraphs in Vienna. The usual sawtoothed arresters are used, except that the points are separated about 3 mm, which is about three times the usual amount, thus requiring a higher voltage to discharge across them. Besides these there is a sort of shunt gap consisting of pointed carbon rods which are easily replaced, and the points of which are brought very close together; when carefully adjusted, using a piece of thin paper as a gauge, alternating currents of 50 to 60 volts and continuous currents of 80 to 100 will pass over this gap. There are three blocks, one connected to the incoming line and the other to the outgoing line, the third between them being connected to earth; the points of the three carbons come close together.

SIGNALLING WITHOUT CONNECTING WIRES. Edser. Lond. "Elec. Eng.," June 3.—The beginning of an article in which he intends to give a popular account of the theory which must underlie any system of establishing electrical communications without connecting wires.

HERTZIAN TELEGRAPHY. Guisot. "L'Eclairage Elec.," May 28.—A short article describing the early work of Popoff, a Russian professor at Cronstadt, in this field; it is claimed that he was earlier than any of the others in approaching the practical realization of telegraphing without wires.

SELECTOR. Voisenat. "L'Eclairage Elec.," June 4.—A long, illustrated description of the selector of the Electric Selector and Signal Company of New York, the object of which is to close a local circuit for various purposes, such as starting a motor, lighting or putting out lamps, operating a signal, etc., through one wire.

TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," May 29 and June 5.—The continuation of his long article; he continues the description of underground and overhead lines.

WIRELESS TELEGRAPHS. Keeley. "Can. Elec. News," June.—An article discussing briefly the various methods. He questions the reasonableness of the great expectations from such means of communicating, and shows how much must still be accomplished; he suggests that the alleged Hertz waves may not be such waves at all, and that if this is the case the methods used will undergo some emodification and simplification.

LONG-DISTANCE TELEPHONE LINES.—"Can. Elec. News," June.—A map showing the Bell Telephone Company's long-distance lines in Ontario and Quebec. Another article gives some of the data of the long-distance telegraph line which is to be run from Montreal to Vancouver and is to be a copper wire weighing 300 pounds per mile.

SELECTING TELEPHONES. Clausen. "West. Elec.," June 18.—A short article showing how to select a bridged-circuit telephone.

SELECTION OF TELEPHONES. Dobbs. "Elec. Eng.," June 16.—In this continuation of his long serial on telephone work he discusses the selection of instruments.

Miscellaneous.

ELECTRIC HEATING AND LIGHTING.—"Elettricista," 17, p. 71; noticed briefly in "Science Abstracts," May.—A paper giving some interesting figures regarding the cost of electrical heating and lighting. Fifty liters or 1.76 cubic feet of gas produces 4 cp hours in a fishtail burner, or 20 in an incandescent burner; the same amount of gas with a gas engine and dynamo will produce 16 cp hours; the large calories given out directly are 225 and electrically 45. A kettle taking 550 watts boils one liter (1.76 pints) in twelve minutes, at a cost of 1.32 cents at the rate of 12 cents per unit; a stove will keep a room 22° C. above the outside temperature, supposing the air to be changed once every hour, with a consumption of 65 watthours per cb. meter capacity of the room. An iron plate with an inside temperature of 250 and outside 200° C. in air at 15° C., will radiate 1 kw or 860 calories per hour, with a surface of 0.13 sq. meters.

CANADIAN ELECTRICAL ASSOCIATION.—"Can. Elec. News," June.—The programme of the next meeting, accompanied by portraits and short biographical sketches of the officers and authors of papers. Illustrated descriptions of some of the sights of interest in Montreal are also given.

Cooling Large Transformers by Air Blast and Natural Draft.

To dissipate the heat generated in the cores and coils of transformers of large capacity offers considerably greater difficulty to the designing engineer than is the case with small transformers in which any design, consistent with reasonable efficiency, gives sufficient external surface to allow heat generated to radiate and so prevent undue rise in the temperature. With large transformers, however, the heat generated in the interior has less opportunity to radiate, and to dissipate it effectively without sacrific of proportion or efficiency requires most careful design.

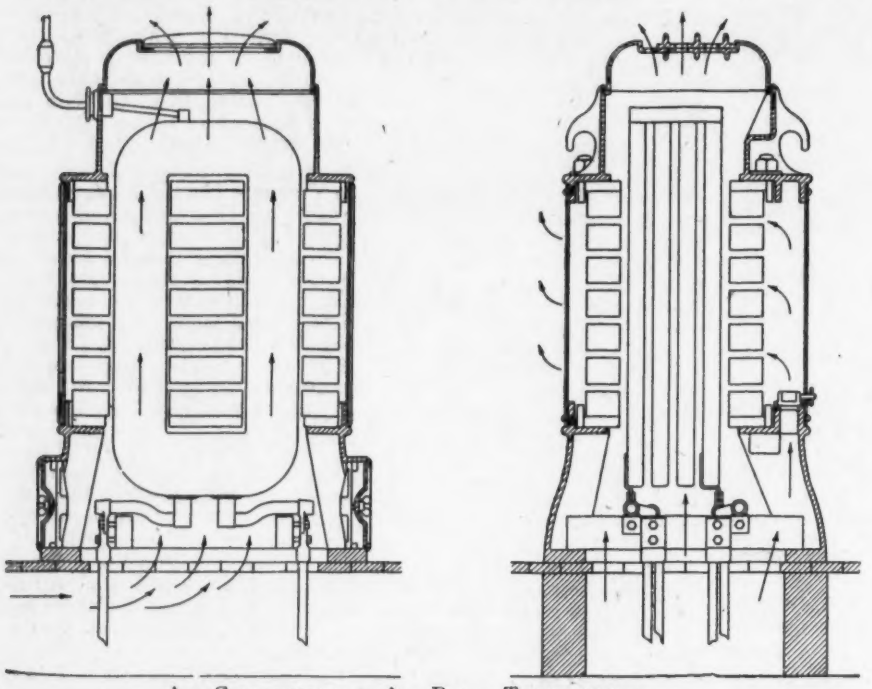
To construct large transformers, say, of 100-kw capacity or larger, placing dependence for low temperature entirely on external radiating surface, necessitates too great a departure for economical proportions, and various designs have therefore been adopted in which provision is made for the circulation of a cooling medium through the interior of the transformer. If ducts passing entirely through the body of the winding are provided, they must be comparatively narrow, or the size and cost of the transformer will be excessive and the efficiency low; the space wasted is too great. With narrow ducts oil is not a reliable cooling medium. Its circulation under the best conditions is sluggish, while the ducts tend to close gradually under two causes—the swelling of the insulating wrapping on the coils and the collection in the ducts of a deposit derived from the slow solution of the various liquid insulations employed when winding the coils. To overcome these drawbacks a new design was introduced in which the height of the laminated core is small compared with the external dimensions of the punchings. A large proportion of the copper is external to the core, and the exposed ends are so spread apart as to give wide openings between the coils for the access of the oil. This design insures a low temperature in the exposed part, and even a moderate average temperature (measured by increase in resistance), but the central portion often becomes dangerously hot without giving any direct evidence of the fact; and it is no less serious to have a high temperature in any part of the transformer than to have the entire winding at an unsafe temperature.

In large transformers the use of oil is undesirable for reasons other than its poor efficiency as a cooling medium. The General Electric Company introduced and adopted the system of air cooling for its large transformers. In air cooled transformers currents of air pass constantly through numerous narrow ducts, and come into direct contact with the heated surfaces absorbing their heat. Low temperatures are secured without sacrifice of efficiency or increase of cost, and the insulation, being constantly in contact with the current of air, needs no additional protection to guard against deterioration.

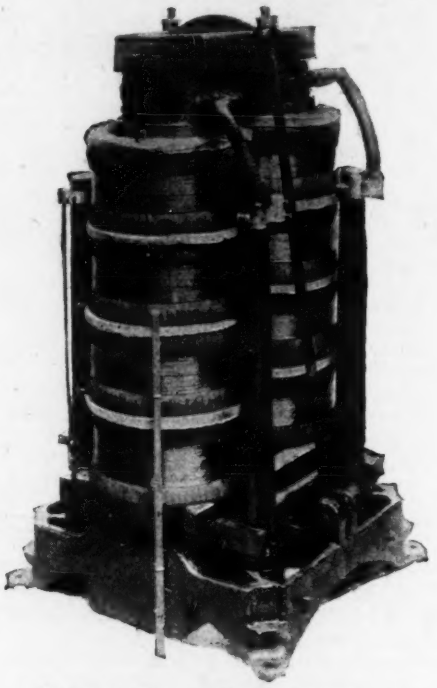
Two methods are employed as standard practice by the General Electric Company in the construction of its large transformers. In the air blast type the current of cool air is forced upward through the core and windings. In the natural draft type the coils and iron are so proportioned and placed that large surfaces are exposed, and the temperature kept within safe limits by the natural circulation of the air.

The air blast type is designed for continuous operation, large output and high potential. In this type, the windings are sub-divided into numerous independent coils, each separately and heavily insulated. With such sub-division the voltage generated in a single section is low even in transformers wound for a voltage of 15,000 to 20,000 volts, and the numerous air ducts between all the coils which this sub-division allows, in addition to the spaces in the iron lamination of the core, limits the rise in temperature to a few degrees only above that of the active cooling air current. The coils are wound with flat copper conductors, cemented together by an insulating compound before the exterior insulation is applied. The method of winding and insulating produces a strong coil, which will successfully resist any tendency of the conductors to vibrate. The primary and secondary coils are assembled in small intermixed groups with air spaces between coils, and between every adjacent primary and secondary section are solid insulating diaphragms, which completely encase the primary winding except at either end of the core, necessarily left open to allow the air to circulate freely. At the end, however, the diaphragms project far beyond the coils, so that a surface insulation of great extent is provided between the primary and secondary. An additional insulation casing is placed around the entire structure of assembled primary and secondary coils, and separates the whole winding from the iron punchings assembled within and around them.

The cooling current of air is obtained from a motor-driven blower, and is forced from below through separate paths at right angles to each other, vertically through the windings and horizontally through the core. The admission of air is controlled by shutters at the top and at the side of the transformer.



Air Circulating in Air Blast Transformer.



Natural Draft Transformer.

The power for the blower seldom exceeds one-quarter of 1 per cent of the total capacity of the transformer, and in most cases is much less, frequently not more than one-tenth of 1 per cent. It is considerably less than that which would be required to pump oil through an oil-cooled transformer of the same capacity.

Air blast transformers are used on 15,000 volts potential or under, and are constructed for higher potential when necessary. The efficiency under full load and partial load, determined under commercial operation conditions, is said to be extremely high. The regulation on both inductive and non-inductive loads, similarly determined, is remarkably close—an important essential when incandescent lamps and motors are operated from the same transformer. Over 100,000 horse-power in these air blast transformers has been installed, and no record yet exists of a burn out due to heating or overload.

In the natural draft transformers the dissipation of the heat is obtained by a natural circulation of the air around the coils. The core is formed of two upright legs on which the coils are wound. These are joined together by two yokes, which complete the magnetic circuit. The transformer proper is surrounded by a corrugated iron case, and rests on a substantial base of cast iron. The cool air enters from below and in passing through the transformer absorbs the heat and ascends, finding easy egress through the hood at the top.

Natural draft transformers are built in sizes ranging from 5 to 200 kilowatts. They require no attention, no blower outfit and may be located in any convenient place. The standard pressure for which these transformers are wound are 10,000 volts primary and 3120 volts or under, secondary. Transformers of higher primary voltage are built to fulfill special requirements.

New Telephone Desk Set.

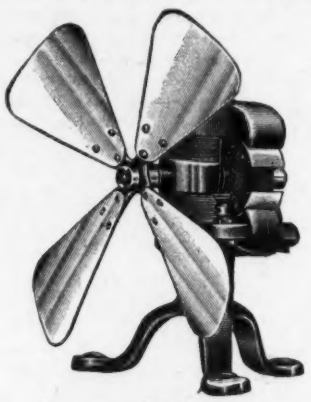
The illustration shown herewith represents the latest type of desk set made by the Ericsson Telephone Company, New York City. In its construction the lightning arrester in the machine itself is done away with and all contacts are carried to the extreme end of the cord. It is equipped with the company's special Ericsson lightning arrester, which has just been brought out. The company guarantees these instruments against injury on any high or low tension currents. This set is wound for bridging or series, and is a new departure of the company as regards this particular type of instrument. The hand micro-telephone used in connection with the set has a double cut-out in the handle, which prevents any conversation being overheard through the telephone. The convenience of this will be generally appreciated.

NEW DESK TELEPHONE.

The company will have an exhibit on the occasion of the annual meeting of the National Independent Telephone Association of America, which will be held at the Palmer House, Chicago, on June 30, July 1 and 2

New Battery Fan Motor.

The Kent Electric Manufacturing Company, Worcester, Mass., is putting on the market a new battery fan, the motor part of which is of the same type as the "Type C" motor, which it brought out last fall. The simplicity and compactness of this motor give it a very neat appearance. It has but one bearing, 3 inches long. This bearing is a portion of the field magnet frame, at a point where the magnetism is neutral. Thus the shaft can never get out of alignment



BAITERY FAN MOTOR.

or bind, and there are no bearings to adjust. Another advantage which will be appreciated by motor users is that there is no bearing on the commutator end where the oil runs onto the commutator, and prevents the brushes from making good electrical contact.

The binding posts are conveniently located at the side of the field coil, and are entirely out of the way. It is constructed with the company's regular drum armature, which it has been putting into its motors for the past two years. This armature insures noiseless running and high efficiency.

This motor is constructed for the most convenient and economical use on battery circuit. It carries a 10-inch fan, and is finished in black enamel with nickel trimmings. The neatness and simplicity of this outfit make it bid fair to become very popular for battery work.

Central Energy or "Express" Telephone Systems in Independent Exchanges.

The independent telephone exchange recently opened at Lockport, Ill., is a most substantially built and most perfectly and conveniently equipped system. The outside construction is metallic throughout, using a large amount of cable on the principal leads and put up in the most substantial manner.

The equipment of the exchange was furnished by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, and is the first public exchange equipped with its central energy system. This system was thoroughly tested in a number of large private plant exchanges for more than a year before adopted in public exchange work. In general operation it is similar to the old line express system, but is claimed to in no way infringe existing patents. There are no generators at the subscribers' stations. The subscriber signals central office by pressing a push button, which completes a circuit formed by one side of the line, and the ground has a return which throws in the power

FIG. 1.—SUBSCRIBER'S TELEPHONE.

generator at central office. This current may be either battery or power generator.

This system requires the ordinary metallic construction with a ground return for the ringing circuit. The talking is over the metallic circuit and independent of the ringing when connected, and leaves the subscribers entirely free from generator induction.

Fig. 1 shows a central ringing and local talking energy wall telephone.

The receiver of the subscriber's station equipment is claimed to be the most powerful and strongly built instrument of its kind. It is composed of a neatly designed, heavily nickel-plated cast brass adjustable head, in which all parts are firmly fastened. The magnet is of one part of high-grade steel, horseshoe shaped, with its pole ends fastened in one part of the brass head, leaving the yoke end free. With but one end fastened the difference in contraction and expansion between the steel and the rubber shell, in great variations in temperature, will in no way affect its adjustment. In the inside of this part of the adjusting end are clamped a pair of coils to the two pole ends of the magnet. This part is then sealed with an insulating compound to prevent moisture or any foreign material entering. In the other part of the adjusting end is fastened the diaphragm. The magnet being extremely powerful enables the use of a very heavy coke tin diaphragm, the vibration of which produces the sound

FIG. 2.—THE SWITCHBOARD.

waves with much greater force than is produced with a weaker diaphragm. The two parts of the adjusting head are provided with a very fine thread, and are screwed together until the diaphragm is in proper relation with the magnet coil, and are then locked with a check ring, and can only be opened with a wrench provided for that purpose. The diaphragm is covered with a hard rubber cap, and the magnets with a shell of the same material, both of which

are tightly screwed to the brass head. The cord is fastened inside of the shell on an insulating block between the two parts of the magnet.

The transmitter is of the granular carbon type, with a case of two parts of stamped brass, nickel plated. One part contains the back electrode, which consists of two screens divided by No. 18-wire ring. The electrode is mounted on an adjustable block, which screws into an insulated bushing fastened in the hub of the back part of the case. Around the back electrode is mounted a ring of silk plush, the threads of which enter the screening of the front electrode and form a perfect cup for the carbon. The front screening electrode is permanently riveted on the diaphragm, which is clamped in the case with an auxiliary diaphragm of rubber-covered cloth. This auxiliary diaphragm prevents the entrance of moisture, which causes a buckling of the metal diaphragm and a packing of the carbon. An air space between the two diaphragms serves to soften the sound. The back electrode being an adjustable block enables extremely sensitive adjustment of the transmitter to take up faint sounds at a distance or to have it muffled to take up sounds only when close to the mouthpiece. A large amount of contact formed by the separated screen electrodes makes the battery requirements exceedingly small in this instrument. The receiver being locked and the transmitter riveted prevents inexperienced people from opening and deranging the parts.

The switchboard used in this system is a regular metallic board, and is shown in Fig. 2.

Long Distance Wall Telephone.

Fig. 1 shows a wall telephone which is especially designed to meet the requirements of both general exchange and long distance work. The magneto is provided with binding posts for receiver, battery and induction coil, which

Fig. 1.—Wall Set.

important feature allows the detachment from the back board, without cutting either the battery or transmitter wires. The finish of the generator is exceptionally fine, and the steel used in the same is of the best magnet brand. The armature is made of the best soft laminated iron, assembled on steel shafts and accurately fitted. A chain and sprocket wheel are used for driving, and the special hard-steel chain is guaranteed not to stretch or wear. The standard generator rings through 10,000 ohms. The switch hook is of the long-lever type, well made, and all contacts are platinized to insure good connections. The transmitter and receiver are of the best quality. The receiver is of the single-pole laminated magnet type, and is stated to be a very sensitive instrument, which quality is due largely to the fact that the utmost care is exercised in its construction. As a whole the set is claimed by the manufacturers, Messrs. Schmidt & Bruckner, 209 Greenwich Street, New York, to be one of the best in the market.

Electrically Driven Freight Ramps.

There has recently been devised a comparatively new application of electric power, in connection with an interesting labor-saving and labor-assisting device, known as a traveling freight ramp. This machine is designed for the economical and rapid loading and unloading of freight to and from vessels, and the accompanying illustration is a detailed side view of one of six installed for the Northern Steamship Company, at Buffalo, N. Y. Essentially it is an adjustable gangway, made up of a stationary and a moving part, being pivoted at one end and counterweighted at the other; so that from the horizontal plane in which the sketch shows the machine it may be raised and lowered to have its outboard end meet the ports of vessels of different heights.

The traveling, or carrying, portion of the ramp consists of an endless apron composed of metal-covered planks attached to two strands of chain running around head and foot wheels, the apron being carried on its upper and lower runs by small wheels traveling on T-rail tracks, as the sketch will make clear. At either side of the foot projects an arm for the reception of one end of the brow plate connecting the ramp with the vessel to be loaded or unloaded. It will be noticed that this arm has a series of recesses; so that in whatever position the ramp may be placed, the brow plate is readily made to form an unbroken path from the vessel to the traveling apron.

The ramps at the Northern Steamship Company's pier are about 25 feet long, the moving portion of each running at the rate of 108 feet per minute, and the direction of travel being reversible, the same machine will carry freight either to or from the vessel. Supposing, for instance, that a vessel is to be unloaded, and that its port is below the level of the wharf, the hand chain shown in the cut is operated to raise the counterweights, and so correspondingly lower the outward end of the ramp, which is locked in the desired position by the worm gearing of the hoisting arrangement. The brow plate is then adjusted, and the men push their loaded trucks on to the moving apron. Instead of requiring the assistance of several others to get the freight up the incline (we will say it is 20 degrees), the wheels of the trucks are allowed to rest in the recesses formed by the metal-covered planks, and thus each man is relieved of his load until he arrives at the warehouse end of the wharf, where he unloads and then returns to the vessel by way of the stationary part of the machine.

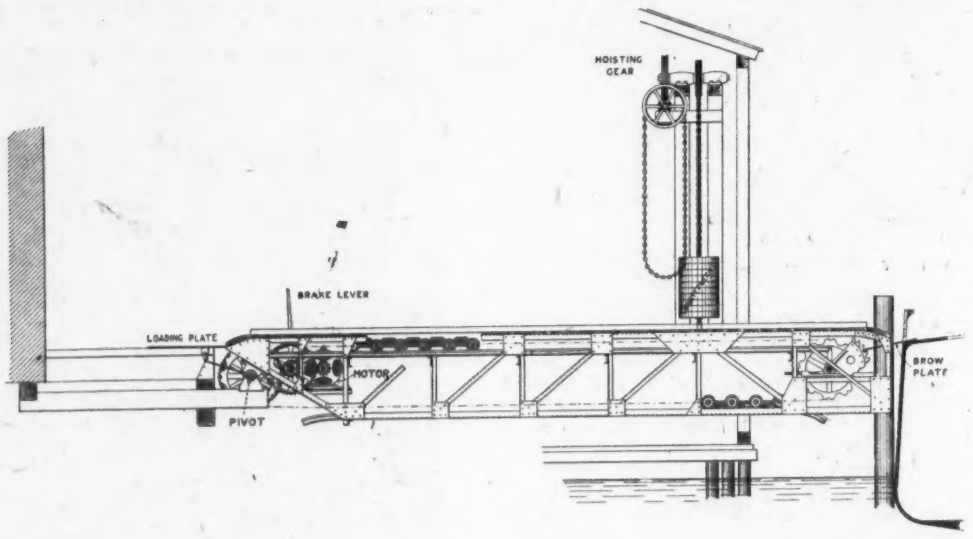
Not only is a decided economy in labor effected by the use of this apparatus, but the time required to handle a fixed amount of freight is materially reduced; a valuable consideration, in that the vessel's detention at the pier is of much shorter duration and the pier is accordingly enabled to accommodate a greater number of vessels in a given period.

To operate each of these machines there is used a 5-hp alternating-current motor, which, it will be observed, is located between the upper and lower runs of the traveling apron, an arrangement that puts the motor in an out of the way and easily accessible place and utilizes an otherwise useless space. By means of a friction clutch the traveling portion of the ramp is readily started or stopped, and through the medium of a brake it is prevented from running down hill when the clutch has been thrown out of gear.

At the Metropolitan Steampship Company's Boston pier four similar machines are in operation. At this point, on account of the salt water waves, the motors are placed overhead, under the roof of the wharf.

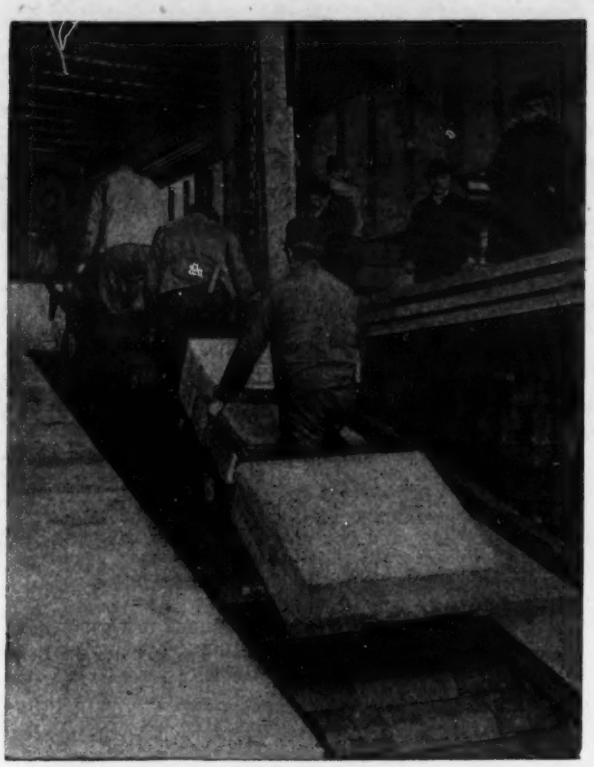
The ramp design is one that can readily adapt itself to the conditions found at different harbors. At New Orleans, for instance, where the rise and fall of the river is from 30 to 40 feet, the Southern Pacific Railway Company has installed a number of these machines, each about 100 feet long. Here the ramps are in pairs, i. e., one for loading and the other for unloading, the stationary gangway being dispensed with, and are run at a speed of 240 feet per minute. A great deal of the freight (canned goods, barrels of molasses or sugar, etc.) is transferred to or from the vessels without using trucks. Where trucks are employed no one, as a rule, accompanies them on the ramp, the men at the discharging end taking care of them as they arrive, unloading them and returning them on the machine traveling in the opposite direction.

The construction of the ramps is such that the wear and tear upon them is



Detail View of Electrically Driven Freight Ramp.

practically nothing, and one company using a large number of these machines reports that they saved their cost in less than a year.



ELECTRICALLY DRIVEN FREIGHT RAMP.

The Link-Belt Engineering Company, of Philadelphia and New York, and the Link-Belt Machinery Company, of Chicago and New Orleans, made the installations referred to above and reports quite a demand for these freight carriers.

Exhibits at the Philadelphia Electrical Exhibition.

ONE OF THE BEST PROOFS of the advantage of having wide-awake men about an exposition building is the success that is rewarding the efforts of Professor Marks, who is at the head of the Philadelphia Electrical Exposition. No mistake was made when the professor induced Mr. F. R. Upton to remain in Philadelphia, to aid him in entertaining his friends and patrons. It is only just ot say that, due to the efforts of Mr. T. G. Seixas, many have spent pleasant hours wandering here and there, inspecting the numerous appliances and inventions. Mr. T. G. Seixas represents the Edison Electric Light Company of Philadelphia, and the interest he has taken in the Exposition will be felt not only by the Edison Company, but by future electrical exhibit promoters. His writings for the daily press of Philadelphia have interested many, as his explanations of the varied uses of electricity are plain and instructive, as are also his answers to his many friends and questioners.

MR. ALFRED F. MOORE, 200 North Third Street, Philadelphia, Pa., makes an exhibit of office and annunciator wire, fire and weatherproof wire, heavy railway feeder, rubber wire, incandescent lamp cord, switchboard cord, telephone receiver cords and various battery cords, double cotton magnet wire from No. 1 to No. 20, single and double silk magnet wire from No. 20 to No. 40, etc., etc.

THE STANDARD FIREPROOFING COMPANY, 39 Cortlandt Street, New York, and Perth Amboy, N. J., has a very fine exhibit on the main floor of the hall of its vitrified and salt-glazed underground conduits. One of the principal products of the company is the self-centering conduit, 18 inches long, which is claimed to be the best and most up-to-date conduit on the market. It is easy to handle, and can be readily and economically laid, and the joint is said to be the strongest made. These conduits are laid one on top of the other, like brick work, and when laid in a bed of concrete with all joints cemented, it becomes one solid mass of masonry. The company also makes the 18-inch conduits in three or four ducts, with either self-centering joints or plain ends. The salt-glazed conduits are manufactured of fire clay mixed and prepared in machines specially constructed for the company's use. They are properly dried, thoroughly and uniformly burned, heavily glazed inside and out, and are made in any length desired up to 6 feet, in two, three, four and six ducts. They may be perfectly aligned. The outer walls and partitions are nine-sixteenths of an inch thick. The duct or opening is 3¼ inches by 3¼ inches, with rounded corners, and the ends fit exactly. They are provided with openings for use of iron dowel pins. The partitions add to the solidity and strength. A 6-foot six duct conduit laid on supports 5½ feet between bearings will sustain, it is reported, eight tons, and when laid on the smooth bed of concrete, it is claimed that there is no limit to its resistance to crushing. The construction of the multiple ducts affords an economical means for laying, no high-priced labor being required. The interior of the ducts is highly glazed, and the round corners reduce the friction to a minimum, thereby lessening the resistance and saving wear and tear on the cable. These ducts permit of the manholes being placed far apart. They are proof against frost, heat, water and acids. The capacity of the Standard Fireproofing Company to turn out these ducts is said to be practically unlimited. The company states that it can produce 5 miles of conduits per day. Its supply of raw material is inexhaustible, and its machine and kiln output are very large. The exhibit is in charge of Mr. M. J. Harrington, of the Perth Amboy, N. J., office. The

THE STANDARD FIREPROOFING COMPANY'S EXHIBIT.

company is represented in Philadelphia by Mr. Franklyn A. Lee, whose office is at 403-404 Betz Building.

MR. GEORGE M. DE GINTHER, 1037 Walnut Street, Philadelphia, has an exhibit that is of particular interest to those in any way connected with the lighting interests. He shows a full line of holophane glass globes which "lose the glare, but not the light." The perfect diffusion effected by these globes is shown in the accompanying cut of the exhibit, which was made from a photograph taken with many of the lights burning. A particularly at-

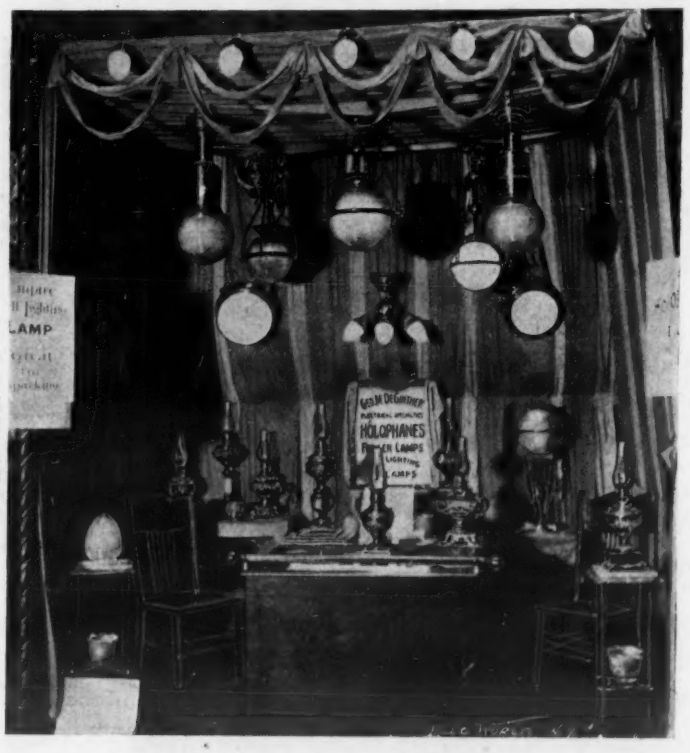


EXHIBIT OF GEORGE M. DE GINTHER.

tractive feature of this exhibit is a large globe with changing blended colors. The oil lamps seen in the illustration are all fitted with the new self-lighted attachment, which is being handled by Mr. De Ginther. This device was briefly described in the last issue of THE ELECTRICAL WORLD. This self-

lighting attachment is one of the most popular articles at the exhibition. Mr. De Ginther also shows a full line of the new "Fowler" incandescent lamps, which was described in The Electrical World of June 18. No plaster is used in cementing the bulb to the lamp base. It is stated that this lamp is becoming widely and rapidly known, and bids fair to rival the sales of the largest concerns.

THE HELIOS ELECTRIC COMPANY has two exhibits, one of fifty-four arc lamps lighting the front of the building, which at night illuminate Chestnut Street for blocks, and the other at its tastefully decorated booth in the exhibition hall proper. Here are shown both open and enclosed arc lamps for all purposes; direct current constant potential enclosed arc lamps, burning singly on 110 and 220 volts, for both indoor and outdoor service, and in designs ranging from the neat and durable black japan enamel to the highly ornamental lamps just brought out by the company. These are in every respect equal in appearance to the best French bronzes. The company also displays a number of arc lamps in various finishes for 220 and 550 volt circuits; also a full line of alternating lamps. The exhibit is in every way creditable to the company, and the uniform and steady burning of the lamps has been favorably commented on.

AN INTERESTING EXHIBIT at the Philadelphia Electrical Exhibition is that of Rudolph M. Hunter, Philadelphia's well-known electrical expert. His booth is very luxuriously fitted up, and forms an attractive spot. His exhibit is historical in character and shows the extent of his work in the inventive field on the subject of the application of electricity to the industrial arts. He shows one of his early trolleys, a series multiple controller and models of the electric railway trucks used on street car and train work. He also exhibits a model train one-twentieth full size, having electric motors upon each axle in permanent electrical connection, and controlled by his improved counter E. M. F. system of regulation, which entirely does away with the necessity of complicated circuits, resistances and the series-multiple controller principle. He exhibits also full-sized controllers for this new method of regulation. Some searchlights are also displayed, one of which is on an entirely new principle employing a revolving positive carbon and dispensing entirely with the use of reflectors. It is contended that this lamp, though small, is exceedingly powerful and much cheaper than the present types of searchlights of the same power. His exhibit also contains other forms of searchlights, electric meters, a small working model of a series-multiple controller for showing the operation to the public, electric switches and a large X-ray apparatus. Aside from these exhibits he has a series of volumes of patents, photographs, pictures, publications, etc., showing the comprehensive nature and scope of his past work in the electrical field, not only in the continuous current work, but also in the alternating transformer system. His work in smokeless powder in 1883 is also included.

MESSRS. MORSE, WILLIAMS & CO., 1105 Frankford Avenue, Philadelphia, have an exhibit consisting of a high-duty direct-connected electric elevator for passenger service. This elevator has a capacity of 2700 pounds at a speed of 250 feet per minute, and is connected to one of the firm's type "F" controllers. The controller contains the limit stops, slack-cable, dynamic brake, reversing switch and armature resistance, and can be regulated so that a constant or variable speed can be obtained. A belt elevator with a capacity of from 2000 to 10,000 pounds is also seen running from a 5-hp reversing motor and controller, and is controlled by the firm's handwheel device. A model house elevator and dumb waiter with automatic stops is also shown in operation. A large-sized model of the Hindley worm and wheel, with which all the drum-type elevators of this company are equipped, is also shown.

MESSRS. VALLEE BROTHERS & CO., 625 Arch Street, have an attractive exhibit which occupies two spaces near the electric fountain. The "Victor" incandescent lamp, which has been handled exclusively by this firm for the past five years, and which is liberally displayed in the exhibit, is manufactured by the Davis Electrical Works, Springfield, Mass. The lamp has always given the best satisfaction, and this alone, Messrs. Vallee Brothers & Co. claim, is the reason for the constantly increasing demand for it. The Union Traction Company, of Philadelphia, is one of the largest users of the Victor lamp, its cars having been equipped with them for the past two years. Another feature of the exhibit is the Victor non-short-circuiting burner, which is being manufactured by the same company, and is now ready to be placed on the market. The advantages claimed for this burner are that it is absolutely non-short-circuiting and that it permits no escape of gas. The tablet boards and switches displayed by this firm are regarded as among the finest that have ever been exhibited in the "City of Brotherly Love." The Victor torch, improved in size, is also attracting considerable attention. The advantages of this torch are that the point of the blow-pipe flame can be placed exactly where it is needed. Instead of punching down the wick or pulling it up to get it opposite a fixed blow-hole, all that is necessary is to place the blow-hole opposite the centre of the flame. This firm has always enjoyed the reputation of handling nothing but the very best, and it had this in view when it chose the agency for the Diehl ceiling fans. There are 1000 users of this fan in Philadelphia alone. The Paragon direct current desk fan, the Westinghouse alternating desk and the Tuerk alternating ceiling fans are also handled by this firm. Mr. Dale B. Scarborough is in charge of the exhibit, which also includes the Lewis cutout and lightning arresters, Armorite steel conduits, for which this firm is sole agent. It is agent also for the Whitney instruments and the American Electrical Heater Company, Detroit, Mich.

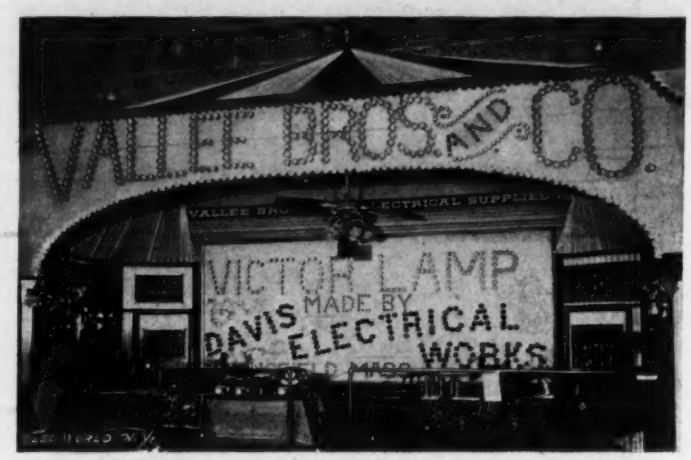


Exhibit of Vallee Brothers & Co.

THE AMERICAN ELECTRIC METER COMPANY, Ninth Street and Montgomery Avenue, Philadelphia, has a very attractive exhibit of nine of its meters in different sizes. There are three 10-ampere, three 20-ampere and three 40-ampere; three-wire meters in circuit, with lamps burning to show the meters in operation on increasing and decreasing the load. There are besides two 10-ampere meters of the three-wire type on stands with the mechanism exposed to view. These meters are provided with a compound pendulum actuated by electricity, which keeps a record of the time, and a solenoid, which measures the amount of current passing. The product of the two factors is given in ampere hours. A pointer moving over a scale shows at each instant the exact amount of current which is passing; and a counter, with five figures in a line, shows the number of ampere hours which have already passed through the instrument. Friction has been practically eliminated in the construction of this instrument, therefore, it has great accuracy. It was the aim of Prof. W. D. Marks, the inventor of this meter, to produce an instrument which could be handled and installed by an average workman of an electric station, and one which would not require subsequent calibration or the services of an expert. By the use of this instrument the consumer can tell at any moment just how much current he is using and can read on the counter the number of ampere hours which he has already consumed. The exhibit is very neatly draped in palms and American colors, and is in charge of Mr. Joseph S. Parker.

Morse, Williams & Co.'s Exhibit.

Exhibit of the American Electric Meter Company.

NEWS OF THE WEEK

Financial Intelligence.

BELL TELEPHONE BONDS.—It is stated that the recent issue of $5,000,000 American Bell Telephone Company's 4 per cent. bonds, due July 1, 1908, are nearly half sold.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
9 Murray St., NEW YORK, June 27, 1898.

THE TELEGRAPH OPERATORS of the Police Department of the Borough of Brooklyn will receive a salary of $1850 a year if the action of Justice Maddox of the Supreme Court in Brooklyn is sustained by the Appellate Division, and no further legal complications ensue. The operators' salaries were increased $100 a year on December 15 last, from $1750, but in January the Police Commissioners cut the salaries down to $1500. Justice Maddox granted a peremptory writ of mandamus on June 24 to compel the Board of Estimate and Apportionment to provide funds to pay the operators their salary at the rate of $1850 a year. A stay was granted to the Assistant Corporation Counsel pending an appeal.

JUSTICE BISCHOFF on June 22 dissolved the temporary injunction obtained by Mr. James J. Phelan, a shareholder in the Municipal Electric Light Company, of Brooklyn, to restrain the Edison Electric Illuminating Company, of Brooklyn, from carrying out an agreement made with the majority of stockholders with the Municipal Company. Judge Bischoff held that the contemplated purchase of the Municipal Company by the Edison Electric Illuminating Company is legal. The Edison Company desires to purchase the holdings of the stockholders of the Municipal Company, they depositing with a trustee the shares held by them at an advance of 100 per cent. on the par value of the stock, payable in cash, by the delivery of bonds secured by a second mortgage on the property of the Edison Company.

VOLUNTEER ENGINEERS GET A TASTE OF ARMY LIFE.—The first detachment of the first regiment of United States Volunteer Engineers was transported to Peekskill from this city on Monday last. It was the first experience in "roughing it" for these men, many of them whom had left comfortable homes and some of them large incomes to serve Uncle Sam for $20.40 and $15.60 per month. The detachment consisted of eight officers and forty-six men. The First Regiment is in command of Col. Eugene Griffin, of the General Electric Company. Dr. Louis Duncan is a major in this regiment, and William B. Parsons, the engineer for the Rapid Transit Commission, is a captain. Several electricians are in the ranks. Soon after their arrival at camp the men went to work cleaning house, so to speak. They had to sleep on the tables in the mess room the first night of their camp life, as the tents which were expected did not arrive before the sound of the tattoo.

NO SMOKING ON THE BRIDGE CARS.—The elevated railroads in Brooklyn have for years catered to their tobacco smoking patrons to the extent of running smoking cars on its trains. When the question of running these cars across the bridge came up for consideration the bridge authorities showed a decided opposition to the idea, and issued an order that there should be no smoking in cars while they were on the bridge. The elevated railroad authorities, it is stated, find it easier to run only smokeless trains over the bridge than to attempt to stop the men in smokers from smoking while trains are crossing the river. The same orders were issued to the surface railway companies when they began running their cars over the bridge. Smokers, however, have some hope of being able to bring about some agreement between the railway and the bridge authorities in regard to allowing smoking cars to cross the bridge.

THE RAPID TRANSIT QUESTION.—The Extension Committee of the Manhattan Elevated Railway Company held a meeting on June 21, to consider the amendments to the proposed West Street franchise, suggested by the Rapid Transit Commission in its letter of June 9. The committee practically conceded all that the Rapid Transit Commissioners asked, except upon the matter of compensation. The reply of the Elevated Railway Company to the letter of the Rapid Transit Commission, which reply was signed by George J. Gould, president, was somewhat caustic. Mr. Gould calls attention to the fact that more than four months ago, on February 7 last, he suggested to the Rapid Transit Board, with much deference, that letter-writing should cease and that action should take the place of words. Mr. Gould closes his letter by stating that the counsel of the company is ready to meet the counsel of the commission at any time, with full authority to represent the railway company in the final adjustment of all details of the franchise, other than rentals.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 200 Atlantic Ave.,
BOSTON, Mass., June 24, 1898.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, has recently built a 260-drop return-call annunciator of the Ross style for the Indianapolis District Telegraph Company, to be installed in Hotel English, Indianapolis. This is one of a number of large instruments built by this company this spring for hotels in different parts of the country. The company states that its output of annunciators has been exceedingly large the past few months, necessitating running its factory nights to keep up with the orders.

IT IS STATED on the best authority that the Boston & Maine Railroad Company is developing an entensive electric railway system, and will control about 100 miles of such property. It is understood that its intention is to control existing lines at different points in the East, using them as feeders to the steam road, and build other lines where needed. It is now building a new line from Portsmouth to Dover, N. H., a distance of 8 miles. This line is double tracked, 90-pound T rail being used. The power house is being planned in such a way that it can be quadrupled in capacity when necessary. This indicates that the Boston & Maine people intend to extend the system at some future time.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., June 25, 1898.

MR. E. P. KILLION, of Walker & Kepler, of this city, has been appointed selling agent in Southern Pennsylvania and Southern New Jersey for the products of the Prismatic Electric Sign Company, Williamsport, Pa.

THE WILLIAM T. HAINES COMPANY, 136 South Fourth Street, Philadelphia, Pa., is sending out engraved invitations to be present at its office on any day from 9 A. M. to 5 P. M., and receive a Heintz steam trap on thirty days' free trial. A reception is held after each sale.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., June 25, 1898.

THE PLANT of the National Electrolytic Company will begin making chlorate of potash this week. It is the only one of its kind in America, and will have a capacity of 1,500,000 pounds a year. Demand for the article in the manufacture of smokeless powder has raised the price from 6 to 21 cents a pound. All the officers of the company are Buffalonians, with Edward Michael, president.

THE BUFFALO GENERAL ELECTRIC COMPANY is engaged in changing all its transformers and meters from 50 to 100-volt capacity in order to be prepared for doubling the pressure of the current to be received when the new station is ready for use. As the change is not to be made as soon as was hoped it will be the plan of the company to leave nothing undone that can cause delay after the new machinery is in place.

THE NEW TROLLEY LINE from Buffalo to Lockport is progressing fairly well. Contract for a car barn adjoining the Erie station in Lockport, 190x55 feet, has been let, and the transformers are about to be placed in the power house in Tonawanda. They are two of 2500 horse-power. The complications of a legal nature over the Kenmore portion of the road will not delay the opening of the road. This road was found to be bankrupt, as it has no real connections, and a $55,000 mortgage has been foreclosed on it.

TESTS are about completed of the new electric machinery in the power house on the Canadian side of the Niagara. It consists of two three-phase, belt-driven generators of 500 horse-power each. The current is to be 2400 volts alternating. There are also two 20-hp direct current multipolar generators to be used as exciters. A new 1300-hp induction motor is to be placed at once in the electric light station on that side of the river. The Corborundum Company, which is building a factory on the Canadian side, has ordered a 200-hp transformer for reducing the current from 2000 volts to 100 volts.

PITTSBURG NOTES.

PITTSBURG, Pa., June 23, 1898.

MR. WESTINGHOUSE'S GENEROUS OFFER.—Mr. George Westinghouse, Jr., has offered as a gift to the Allegheny University, the entire electrical equipment for the proposed new observatory, consisting of generators, motors, etc.

MESSRS. TATE & JONES, Murtland Building, Pittsburg, Pa., are sending a circular to every street railway president in the United States, announcing that they are in a position to extend to such railways the services of a car trust in financing the purchases of rolling stock. This is a new departure in electric railway financing, and Messrs. Tate & Jones think that it will meeet with favor in this field.

DIVIDENDS DECLARED.—The directors of the Allegheny County Light Company have declared the regular quarterly dividend of 1½ per cent., payable June 30, to stockholders of record June 17. Transfer books will be closed from June 18 to June 30, both inclusive. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. upon the preferred stock of the company, payable on July 1, to stockholders of record. Transfer books will be closed from June 25 to July 2.

OPEN AIR THEATRE IN SCHENLEY PARK.—In order to stimulate summer travel upon its lines, the Consolidated Traction Company has established an open-air theatre in one of the ravines in Schenley Park. Daily after-

noon and evening vaudeville performances are given, to which the admission is absolutely free. A complete change of bill will be made each week, and it seems probable that the increased street car travel at hours when the cars would otherwise run comparatively empty, will amply repay the management for the outlay occasioned by this novel enterprise.

ELECTRIC LIGHT PLANT FOR CITY HALL.—The contract recently awarded by the directors of the Department of Public Works to the Westinghouse Electric & Manufacturing Company, for the City Hall electric light plant, has been approved by Councils. The plant will consist of a 62½-kw, 110-volt multipolar direct current generator, belted direct to a 100-hp Westinghouse gas engine. The City Hall was formerly lighted by electricity supplied by the Allegheny County Light Company. A year or two ago, however, it was decided to reduce the cost of lighting by taking advantage of the fact that one of the gas companies is obliged to furnish to the city, free of charge, 12,000,000 feet of gas annually. A portion of this free gas has therefore been used for lighting the building. It will now be utilized as motive power for the gas engine, and the City Hall employees will have the advantage of superior illumination by electricity, although still using the gas which costs the city nothing.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., June 24, 1898.

RECENT PROMINENT VISITORS in Chicago included Mr. Charles D. Jenny, of the Jenny Electric Manufacturing Company, Indianapolis; Mr. Herbert H. Brooks, general manager of the American Circular Loom Company, Chelsea, Mass.; Mr. G. G. Luthy, of the Royal Electric Company, Peoria, Ill., and Mr. J. C. Hobart, general manager of the Triumph Electric Company, Cincinnati.

MR. STANLEY S. STOUT, who for some time past has been very prominently identified with telephone litigation in behalf of independent telephone companies, died quite suddenly in this city after a brief illness. Mr. Stout represented the interests of the Western Telephone Construction Company, and his work in bringing about the defeat of the Watson and Roosevelt patents, which cover broadly the automatic hook switch used in all telephones, brought him into great prominence. Mr. Stout had a host of friends, and was a prominent member of the Marquette Club.

THE CUTLER-HAMMER MANUFACTURING COMPANY, which represents the consolidated interests of the old Cutler-Hammer Manufacturing Company and the American Rheostat Company, of Milwaukee, has its offices and works at 70-80 West Jackson Street, this city. The capital stock of the company has been increased to $75,000, and a large proportion of this has been invested in new machinery. With its increased manufacturing facilities and larger capitalization the company will be able to take care of its rapidly increasing business in a prompt and satisfactory manner. The officers of the new company are: F. R. Bacon, president; F. L. Pierce, vice-president; J. G. Hickcox, secretary and treasurer; H. H. Cutler, electrical engineer and general manager.

St. Louis Notes.

St. Louis, Mo., June 24, 1898.

THE SUBURBAN ELECTRIC RAILWAY COMPANY having failed to reach an understanding with the Union Depot and St. Louis & Cass Avenue Railway Companies, with reference to terms on which it may run over their tracks on the downtown loop, the question will have to be adjusted by commissioners.

THE CONTROVERSY between the St. Louis, Belleville & Suburban Electric Railway and the Day line has been taken in hand by the East St. Louis City Council. At a meeting of Council this week a resolution was passed to the effect that unless a traffic agreement was made between the Suburban and the City Electric Railway within the next few days the Council would settle the matter. How this would be done was not stated.

THE CHICAGO & ST. LOUIS ELECTRIC RAILWAY.—The Circuit Court refused to grant a mandamus compelling the officers of the Chicago & St. Louis Electric Railway Company to permit George H. Little to see the company's books. The company is the one organized years ago to build an air-line electric railroad between St. Louis & Chicago, and Little alleges that he invested considerable money in the enterprise, and wants to see the books to see what become of the money.

DELINQUENT ELECTRIC LIGHTING COMPANIES.—The Supervisor of City Lighting has sent letters to the Laclede, St. Louis, Edison of Carondelet and Carondelet Electric Light & Power Companies, notifying them that they had not complied with the city ordinances requiring them to file with the comptroller a statement of their gross earnings, and pay into the city treasury 5 per cent. of the same on the first of January and July of each year. The statements and percentages have been due from the four companies above named since January 1 last.

Colorado Notes.

Denver, Colo., June 21, 1898.

ELECTRIC LIGHT FRANCHISE.—It is announced that the City Council of New Castle, Wyo., has granted a six years' franchise for an electric light plant to C. A. Peterson. Work is to commence at once.

AWARD OF CONTRACT.—The contract for the electric light plant in the new building of the Denver Dry Goods Company has been awarded to the General Electric Company. Two 75-kw and one 50-kw machines will be installed.

RAILWAY FRANCHISES.—The Denver Board of Aldermen has adopted an ordinance giving a franchise for an electric railway to the Denver City Railroad Company. The company at the present time operates a cable system on its lines, and it has been losing money steadily; indeed, its losses have been such that it was stated by the management if a more economical system of operation was not introduced the company would be forced into the hands of a receiver. The company is granted a franchise for a term of twenty years, and it agrees to pay as a consideration the sum of $2500 per annum. The company is given the right to use any motive power except steam, but no plan but the trolley system is under consideration. It is provided that the company shall conform to existing regulations in relation to fenders and vestibules. The company is also required to make provision for carrying bicycles. The adoption of the ordinance by the aldermen by no means ends the matter. The measure will now go to the Board of Supervisors, and then to the Mayor. A great deal of opposition has been made to the measure on the ground that the city is not sufficiently compensated for the franchise, and that certain restrictions should be imposed on the company. It is urged that it should be limited to a certain motive power, that it should be restrained from hauling freight, that it should be required to relinquish its old franchise which the company claims is perpetual before it is given a new right. It is announced that if the company is finally given the right to change its motive power it will expend about $400,000 in the improvement. The Aldermen have also passed a bill giving the Colfax Railway Company the right to build tracks on certain streets in the eastern district of the city. This company owns and operates an electric railway in the town of Montclair, a suburb of Denver. Latterly the road has been practically shut down, as it was a losing venture. It is announced that an arrangement for operating the road has been made with the Denver Consolidated Tramway Company. The new franchise will enable the company to make connections with that company's lines.

Pacific Coast Notes.

San Francisco, Cal, June 19, 1898.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY is installing a duplicate of its Newcastle-Sacramento transmission plant. An additional 500-kw two-phase Westinghouse generator is included in the equipment.

LIEUT. W. STUART-SMITH, retired, who until recently was located in this city as a consulting electrical engineer, is now in active service in the steam engineering department at the Navy Yard, Mare Island, Cal.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY supplied a 75-kw direct current generator, to be used for torpedo firing at the mouth of the Columbia River. In all about $15,000 worth of electrical apparatus was installed in that locality.

THE PACIFIC COAST ELECTRIC COMPANY, formerly located at 241 Powell Street, has been consolidated with the California Electrical & Construction Company, E. H. Forst, manager. Mr. Forst will be manager of the combination, which will do business at 1425 Market Street.

THE JOHN M. KLEIN ELECTRICAL WORKS, San Francisco, received the contract for a 50-mile equipment for a signal train to accompany the Philippine expeditionary forces. The principal items were: Four hundred field telegraph lances, to be loaded on lance wagons; 1500 cells of battery, a number of telegraph instruments and single cables to be attached to the lances by rubber and porcelain hooks. The lances are 2 and 1½ inches, round, by 14 feet in length, with sharp butts; to be placed 125 feet apart.

THE WESTERN UNION TELEGRAPH COMPANY now has its Seattle-Victoria, B. C., line in successful operation, via Port Townsend and Port Angeles, Wash. A number of new offices have been established along the new lines. Eight separate cables had to be constructed for this northern extension, the longest being 18 miles in length. The new land lines required the stringing of 125 miles of copper wire. The rate from Victoria to Port Townsend, Wash., has been cut from $1.10 to 25 cents for 10 words. Formerly a message had to be handled by three companies.

THE SOUTHERN CALIFORNIA POWER COMPANY, after an annoying delay, has secured the funds required to complete its 80-mile transmission line to Los Angeles, Cal. The machinery will soon be completed by the General Electric Company. The Edison Electric Company, of Los Angeles, will have entire control of distributing the Southern California Power Company's current at that point. A contract has been let to H. H. French for the construction of a pole line from Crafton station, on the S. P. R. R., to Los Angeles, including connections with the power houses of the Los Angeles Railway Company, the Los Angeles Edison Company, the Pasadena & Los Angeles Railway Company and the Pasadena Electric Light Company. The new transmission system will be in operation this fall.

Canadian Notes.

Ottawa, Ont., June 25, 1898.

THE AMALGAMATION of the Quebec & Montmorency Railway and the Quebec District Railway is said to have been effected. The motive power of the former road will likely be converted to electricity.

THE NEW COPPER WIRE of the Canadian Pacific Telegraph, in course of construction from coast to coast, was completed between Montreal and Winnipeg last week. The first message over the new wire was sent by Mr. C. R. Hosmer, manager of telegraphs, to Mr. Shaughnessy, vice-president of the company. The new line gives the Canadian Pacific Company greatly increased facilities between the Atlantic Coast and the city of Winnipeg, Man.

THE REPORT of Mr. James Milne, the electrical expert employed by the city of Toronto to make a report on the cost of an electric power supply for street lighting and commercial purposes for Toronto, is against the city erecting a commercial plant. Mr. Milne reports that the data received from users of both electric and steam power is not to be absolutely relied on for the purposes of careful calculations, owing to the different bases upon which the various returns have been prepared. The summary of steam users shows a consumption of 16,802 horse-power, from which may be deducted 10,000 horse-power for the Toronto Electric Railway Company and electric light companies' plants, leaving 6802 horse-power for commercial purposes. Of this amount, he says, nearly 1000 horse-power could be supplied by electric power or gas as cheaply as at present, but for the remaining 5800 horse-power it is useless trying to persuade the manufacturers to change from their present methods.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 18, 1898.

THE ELECTROPHONE.—The "electrophone," or, as it was formerly called, the "theatrophone," is now being used to a considerable extent in London. The Electrophone Company has an arrangement with the National Telephone Company, by which subscribers to the exchanges of the latter can obtain communication with certain theatres and concert halls during the evenings and Saturday afternoons, and some of the most popular churches on Sunday, when there is not much demand for junction wires for ordinary conversation. Although the rental is fairly high, the service is appreciated very much, especially that to the St. James' Hall and the Queen's Hall, where, with the exception of at the Opera House, the best music is to be heard in London. One evening last week, at an entertainment given by the Electrophone Company, connection was also obtained through the London-Paris line to the Opera House in Paris, and a performance of "Le Prophète" was extremely relished by the guests.

MUNICIPAL ELECTRICAL SUPPLY.—Much dissatisfaction is felt by the companies supplying electricity in London by the fact that Parliament had granted provisional orders under the electric lighting acts to two metropolitan vestries, one in Bermondsey and the other in Marylebone. In the former district the company has had a provisional order for several years, and has not made use of it, but in the latter case, the Metropolitan Company has been working very successfully for a long period. It is feared that all other vestries will follow suit, so that there may be a disastrous competition to supply companies by these local authorities working in the same area, and having to some extent better facilities than a limited company. On the other hand, it appears that the London County Council wishes to be in a position to undertake the supply of electrical energy "in bulk." At a meeting of the County Council, under the local authorities, held yesterday, resolutions were carried to the effect that the conference regarded it as essential to the interests of London as a whole that the present purchase clause in the Electric Lighting Acts should be made to apply to such companies as propose to supply electrical energy in bulk to the whole of London without regard to area. A resolution was also passed that it was desirable that the London County Council should be in a position to undertake—if it so desired or were so requested by the local authority—to supply electrical energy in bulk for the convenience of any particular districts.

MUNICIPAL ELECTRICAL ASSOCIATION.—In this country a great many more municipal concerns own electric lighting stations and tramways than in America, and the third annual convention of the Municipal Electrical Association, which was held in London, from June 8 to June 11, was exceedingly well attended, and a number of very excellent papers were read. On the first day, after the delivery by the president, Mr. A. H. Gibbings (Bradford), of his inaugural address, a paper was read by Councillor Hesford (Southport) on "The Management of Electrical Undertakings by Local Authorities." This paper provoked considerable discussion from those present, who included not only electrical engineers attached to municipal undertakings, but also chairmen of electricity committees and one or two consulting engineers and manufacturers. The paper was followed by a paper by Mr. J. R. Blaikie, chief assistant engineer at Bristol, on "Switchboard Apparatus," and this, as well as the paper on "Steam Using Plant," by Mr. Jeckell (South Shields), was well discussed. During the afternoon visits were made to the City & Waterloo Railway, which is approaching completion, and to the electricity works of the Islington Vestry in London, and in the evening the annual dinner took place. On the second day three papers were down for reading. The first on "The Uniformity of Plant," by Mr. Wordingham, of Manchester, provoked an animated discussion on the question of standardization. In this country electric light plants have not been standardized in the same way as in the States, and some of the facts brought to light showed a very remarkable state of affairs. The declared pressures supplied by central stations in the United Kingdom vary from 50 to 440 volts, and among them are such remarkable numbers as 84-103, 107-114, 102, 113, 230, etc. One station, Mr. Wordingham stated, which normally supplied at 100 volts, supplies at 102 "by a special arrangement with the lunatic asylum." Of the fifty-eight alternate current stations in the United Kingdom there are no fewer than eighteen different frequencies, varying from 40 to 125, and the list given of the various sizes of generating units is also an extremely long one. During the discussion the blame was alternately attributed to the central station engineers, the consulting engineers and the manufacturers. It was incidentally mentioned that incandescent lamps of a useful efficiency can now be obtained from the manufacturers for pressure as high as 250 volts. The paper on "The Appropriation of Profits and Repayments of Loans," by Bailie Maclay, the convener of the Glasgow Electricity Committee, cast interesting light on the way the various municipal concerns distribute the profits derived from their electrical supply, for over here a great number of muncipal electric lighting concerns are working on a profit making basis and are not a burden on the rates as in America. It appears that some stations deem it advisable to put away all their surplus in various depreciation and renewal funds; others lay aside hardly anything for depreciation, and either supply public lighting below cost price or use the profits to relieve the rates. The private consumers seem to be, as a rule, the last to benefit by the success of these municipal electric lighting schemes. After a hasty discussion on a paper entitled "Single vs. Multiple Generating Stations," during which nearly everybody agreed that no hard and fast rule could be laid down as to the critical limit of horse-power at which a single generating station can be said to be more economical than multiple stations, the meeting adjourned for the day. The majority of the members paid a visit to Messrs Willans & Robinson's celebrated engine works at Rugby, and a few visited the Croydon Electricity Works and the lamps works of the General Electric Company at Hammersmith. The meeting on the 10th inst. considered three papers on electric traction, and the discussion on these, although raising many points of interests, would perhaps appear rather tedious to your readers. Visits were made to Messrs. Siemens Brothers & Co.'s works and to the Shoreditch Electricity Works in the afternoon. The last day of the convention was devoted to the consideration of business questions and the election of council of officers and fixing of the place of meeting for the next convention. Visits were made to the Portsmouth and Dover electricity works. The next convention will meet at Bristol, and Mr. Faraday Proctor, who is chief electrical engineer of the electric light works there, is to be the president.

FRENCH NOTES.

(From Our Own Correspondent.)

PARIS, June 9, 1898.

INTERNATIONAL SOCIETY OF ELECTRICIANS.—The regular monthly meeting took place on June 1 at the rooms of the Society of Encouragement. The president, M. R. V. Picou, was in the chair. M. Ducretet began with a paper on telegraphy without wires by means of Branly's coherer, and subsequently M. Gosslin exhibited a number of different forms of potentiometers, which are in actual use. M. Ducretet's experiments consisted in sending long and short signals through a circuit, producing them with successive makes and breaks at a transmitting station and recording them automatically at a receiving station with a Morse receiving apparatus. At the transmitting station was a Ruhmkorff coil capable of giving a spark of about 12 to 15 inches in length, and having a mercury interrupter and a mercury hand key connected with the primary coil. The mercury interrupter was operated by a small electric motor driven from a separate battery. The current in the primary circuit was turned on or off by manipulating the key. To the terminals of the secondary coil was connected an oscillator and also two rods ending in spheres. The latter were immersed in an insulating fluid, and sparks passed between them. To each terminal of the oscillator was also connected a wire, one being grounded and the other being connected to a very tall, insulated rod. It was from this rod that the waves started. The waves were received by a Branly coherer provided with an automatic tapper and connected with a Morse mechanical recording mechanism. The experiments were entirely successful and very interesting.

SOCIETY OF ELECTRICIANS.—At the meeting of May 4 M. R. Picou delivered his inaugural speech; he closed with a eulogy on his predecessor, M. d'Arsonval. M. Laporte read a communication on the results of a study of the photometric standards in use at the Central Electrical Laboratory. He obtained some lamps which had been standardized at the Berlin Electro-Technical Institute, and measured them again for purposes of comparison. His results were as follows:

Berlin.....	108.5 volts	0.318 amperes	10 Hefner
	111.5 "	0.489 "	16 "
Central Laboratory.....	108.5 "	0.338 "	8.7 Carcel
	111 "	0.487 "	14.2 "

The author then gave some information on the standard lamps which he used, especially on the Carcel lamp, following the instructions which he received from M. Condorchon, inspector of gas lighting for the city of Paris, and on the Hefner lamp and the paraffine candle, etc. Using the same lamp X the author compared it with the various standards, and obtained the following values for the brilliancy: X = 0.194 (B) standard laboratory lamp B = 1
X = 0.341 Carcel light.
X = 0.72 Hefner light.
X = 3.13 paraffine candle.

M. Laporte states that 1 Hefner = .092 Carcel and that 1 paraffine candle = 0.109 Carcel. These figures are taken from a series of measurements, all of which agreed within 2 per cent. M. Girault spoke on the commutation in direct current dynamos.

General News.

NEW INCORPORATIONS.

THE KANE'S FALLS ELECTRIC LIGHT COMPANY, of Fort Ann, N. Y., has been incorporated with a capital stock of $25,000.

THE MASSACHUSETTS STREET RAILWAY ASSOCIATION, Boston, Mass., has been incorporated under the laws of Massachusetts, and may conduct employers' liability insurance.

THE ROCKFORD ELECTRIC LIGHT & POWER COMPANY, Rockford, Ill., has been formed with a capital stock of $50,000. The incorporators are F. M. Ellis, W. E. Dewey and C. F. Warner.

THE SOUTH MISSOURI TELEPHONE COMPANY, of Pierce City, Mo., has been incorporated with a capital stock of $20,000. Among those interested are S. J. Armstrong, G. R. Armstrong, Albert Newman and others.

THE WHITE PLAINS LIGHTING COMPANY, White Plains, N. Y., has been formed for a period of fifty years, with a capital stock of $50,000. The directors are Winthrop G. Bushnell, New Haven, Conn.; Joseph H. Hall, Port Chester, N. Y., and John C. Bennett, Brooklyn.

THE GENERAL ELECTRIC AUTOMOBILE COMPANY, Philadelphia, Pa., has been organized under the laws of West Virginia, with an authorized capitalization of $2,500,000. The Board of Directors includes J. A. Brill, W. D. Marks, Rudolph M. Hunter and John H. Noblit.

THE CANADIAN BRYANT ELECTRIC COMPANY has been organized at Bridgeport, Conn., with a capital stock of $5000. Among those interested are C. W. Bryant, L. W. Eaton, J. B. Hubbell, E. W. Marsh, H. S. Hubbell and E. M. Scribner. The company has a factory at Montreal.

THE CROWN INCANDESCENT COMPANY has been incorporated at Camden, N. J., with a capital stock of $100,000. The objects of the new company are to conduct and operate electric light plants and furnish heat and power. The incorporators are John Pechin, Robert Barr, Joseph Green and Louis A. Repelto.

THE TELEGRAPH AND TELEPHONE.

HERMANN, MO.—Hermann is to be connected with the long distance telephone system.

BUTLER, OHIO.—The Farmers' Co-operative Telephone Company is building a telephone line from Butler to Belleville.

EVANSVILLE, IND.—The Cumberland Telephone Company has completed its line from Carmi to Mt. Vernon, Ind. This gives Carmi direct communication with Mt. Vernon and Evansville.

CHILLICOTHE, OHIO.—The Home Telephone Company has recently purchased the private line running from Chillicothe to Londonderry, and now has control of another important territory in the country.

ALVIN, TEX.—The Alvin and Angleton telephone line has been completed, and the two towns are now in telephonic communication. There are two stations on the line, one at Pleasant Bayou and one at Amsterdam.

MADISON, WIS.—The Northwestern Long Distance Telephone Company is building a telephone line connecting Flandreau and Pipestone. The line will be extended to Egan, Colman, Wentworth and Madison, and from there to Woonsocket and thence north.

NEW LONDON, CONN.—The Southern New England Telephone Company has just completed the construction of new lines in Noank, Blackhall and Westbrook, the wires from the two first-named villages running to this place, and Westbrook being connected with Saybrook.

PONTIAC, ILL.—The Livingston County Telephone Company has completed its new exchange building. The poles are erected, the wiring now being put up for the removal of its central office. This new office will be complete in every respect, being equipped throughout with the standard apparatus of the Sterling Company, Chicago.

ROCHELLE, ILL.—The Olga County Telephone Company has obtained the right of way to string wires in Creston. The company will immediately extend its line to that city, and will connect with the DeKalb County Telephone Company's line. The Olga County Telephone Company has recently increased its capital stock from $5000 to $10,000.

EASTHAMPTON, L. I., N. Y.—The New York & New Jersey Telephone Company is engaged in extending its system to include the pay stations of the long distance telephone service in the railroad depots along the Montauk division of the Long Island Railroad. Work of installation is in progress here and at Amagansett, and it is understood that the stations throughout the length of the road are to have the telephone stations added to their equipment.

TRENTON, N. J.—Clarence W. Derby, a convict in the State prison, was pardoned on June 21 by telephone by Governor Voorhees, who was at Sea Girt. The Governor first inquired of the Attorney-General whether his pardon by telephone would be sufficient. The Attorney-General decided that it would. The occasion for this haste was due to the fact that Derby was dying, and it was the desire of his parents to get him home before death intervened.

NASHVILLE, ILL.—The American Long Distance Telephone & Telegraph Company, with headquarters in Chicago, has succeeded in getting the right of way through all the principal counties and cities of Southern Illinois, and now has a force of men at work erecting lines. The main line will extend from St. Louis to Evansville, Ind., and will have direct connection with Chicago and New York. The long distance wires between this city, Mount Vernon and Mascoutah have already been strung.

ATHENS, ALA.—The Town Council has passed an ordinance granting to the American Telephone & Telegraph Company the right to construct and operate telephone and telegraph lines in Athens. The company in return for this privilege has agreed to furnish free of cost to the town the use of its poles for the fire alarm and police wires and to maintain an office for telephone business in this town. This gives Athens a long distance telephone connection and puts her in direct communication with all the trade centres.

ELECTRIC LIGHT AND POWER.

NEW IBERIA, LA.—The electric light plant at this place was totally destroyed by fire recently.

LAWSON, MO.—The Liberty electric light plant has been sold to parties from Leavenworth, Kan., who will enlarge and improve it.

COLUMBUS, OHIO.—Columbus will have her own electric light plant, and the Ambos Construction & Electrical Company has secured the contract for its erection.

LEBANON OHIO.—After an agitation of five years the citizens of this town have voted an issue of bonds for $20,000, with which to purchase the electric light plant.

CHICAGO, ILL.—Dankmar Adler has ben retained to make plans for a power house to be built in connection with the Schlesinger & Mayer's $1,000,000 store at the southwest corner of State and Madison Streets.

ROCKFORD, ILL.—The Rockford Electric Company, after a long and hard fight for existence against heavy odds and finally passed into the hands of a receiver, was sold under foreclosure to T. M. Ellis, superintendent of the Rockford Street Railway Company.

CLINTON, MASS.—The Lancaster Mills, in consequence of the loss of the dam and its water power, are now preparing to use electricity, and are erecting an elaborate power house. They will use a triphase generator, which is said to be the largest generator ever built for this purpose.

PETOSKEY, MICH.—Petoskey voted by an overwhelming majority to bond for $16,000 to buy the Petoskey Edison Electric Light Works of H. O. Rose in order to go into the street and commercial lighting. At the spring election $5000 was voted for a street light plant, and this vote places both lines of business in the hands of the city.

READING, PA.—At the recent sesquicentennial celebration in this city the electric illumination was very effective. There were 5000 16-cp lamps, and these extended for a mile and a quarter along the main street. The work of installing these lamps was done by the Reading Electrical Construction Company, Limited, under the supervision of Mr. A. V. Arrowsmith.

THE ELECTRIC RAILWAY.

SYRACUSE, N. Y.—The electric road of the Syracuse, Lakeside & Baldwinsville Railroad Company will be completed about July 1.

KANSAS CITY, MO.—The Metropolitan Street Railway Company is surveying the route for a new electric street railway in this city. Work will begin on the same early in July.

PHILADELPHIA, PA.—The Shamokin Street Railway Company has been purchased by Congressman M. H. Kulp, of that city, and Judge C. R. Savidge, of Sunbury. The line will be improved and Indian Park made is terminus.

WHITE PLAINS, N. Y.—According to plans decided upon recently, the Tarrytown, White Plains & Mamaroneck Electric Railroad Company contemplates making important extensions, both easterly along the sound and northerly to the Putnam County line.

PHILADELPHIA, PA.—Work has begun on the electric road to connect Lehigh and Kutztown, Pa., for 1 mile westward from Allentown the road is already complete. The entire line will be completed by September 1, and will be operated by the Allentown & Kutztown Traction Company.

CHESTER, PA.—The officials of the Chester Traction Company and the Mayor of the city of Chester have come to an agreement on the terms of the ordinance granting the company the right of way through the streets of the northwestern section of the city, and the ordinance is now in effect. The work will be begun at once.

CHICAGO, ILL.—The Northern Electric Company is applying to the City Council of Chicago for a franchise for fifty years under the terms of the Allen law, so that it may extend its lines to the city limits. The company offers to pay a license fee of $50 per car for the first five years, and after that an additional fee in a percentage of the receipts, the same to be increased each five years, so that the last fifteen years the rate will be 10 per cent. The length of the line is about 3 miles.

CHICAGO, ILL.—It is stated that all the franchises and rights of the Chicago General Electric Railway Company are now owned by the Chicago City Railway Company. The price paid for the property was $950,000. This trade ends a fight which had been waged in and out of court almost constantly for three years. The fight had been a costly one. Including the purchase price of $950,000, it has cost the city railway Company no less than $3,000,000. Once a 60 per cent. interest in General Electric was offered to the City Company at $40,000, and the City Railway refused to buy, while at another time the City Railway people bid $1,450,000 for the General Electric property, and the owners of the latter refused to sell. The principal benefit accruing to the City Railway from its purchase is the removal of a menace which has been hovering over its property for years, holding down the prices of its securities and darkening its future more or less in the minds of investors.

PERSONAL NOTES.

MR. E. L. BRAYTON, of the Pelton Water Wheel Company, San Francisco, who has been at the company's New York office for some time past, has gone abroad on business for his company.

MR. WILLIAM F. OSBORNE, formerly Eastern representative of the "Western Electrician," and now manager of the "National Provisioner," was married on June 20, to Miss Emma Catharine Gale, of Brooklyn. Mr. Osborne's many friends congratulate him and wish him and his bride a long and happy life.

CAPT. GEORGE O. SQUIER, chief signal officer at Governor's Island, New York Harbor, and a well-known writer on electrical subjects and joint inventor of the synchronograph system of telegraphy, has been ordered to proceed to Chickamauga. Captain Squier has been detailed as chief signal officer of General Wade's corps.

MR. KEMPSTER B. MILLER, who is well known by reason of his work as designer and patent expert for the Western Telephone Construction Company, has accepted a position with the International Correspondence Schools, of Scranton, Pa., where he will have charge of the courses in telephony and telegraphy. Mr. Miller's rise in electrical work has been rapid. Born in Boston in 1870, he graduated from the course in electrical engineering at Cornell University in 1893, after which he worked for a time as draftsman with the Thomson-Houston Company Lynn, Mass., afterward entering the patent office as assistant examiner, where he remained in the electrical division for about three years, handling largely telephone cases. During the last two years he has been chief electrician and patent expert for the Western Telephone Construction Company, Chicago. Many of the designs and details used by the company are of Mr. Miller's invention.

TRADE AND MISCELLANEOUS PUBLICATIONS.

THE PHOSPHOR BRONZE SMELTING COMPANY, Limited, 2200 Washington Avenue, Philadelphia, has issued price list No. 13 of its well-known "Elephant Brand" phosphor bronze and other alloys, of which this company is said to be the original manufacturer in the United States, and sole maker.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, in a neatly gotten up catalogue, tell all about Cochrane separators for removing liquids or solids from live steam, exhaust steam, compressed air, ammonia gases, etc. A long list of names of users of these appliances is given, among them being the largest manufacturing concerns in the country. The apparatus itself is described and illustrated in its various forms, and tables of dimensions are given. The catalogue contains forty-eight pages and an index.

ELECTRICAL SPECIALTIES, including attachment plugs, branch blocks, bracket rosettes, cleats, insulators, cutouts, fuse links, etc., etc., as manufactured by Messrs. Pass & Seymour, Syracuse, N. Y., are fully treated and illus-

trated in catalogue No. 10, just issued by this well-known firm. The list included in the catalogue is a very complete one, and everything in the line of china manufacture is included. The firm calls special attention to several specialties recently added to its list. These include attachment plugs, key pony receptacles, bracket rosettes, fusible socket rosettes and all-china junction boxes. This firm has been very successful in making insulators of difficult patterns. It has a plant especially designed for this class of work, and a machine shop fully equipped for die making.

Trade and Industrial Notes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is carrying in stock an improved type of turnbuckles, both galvanized and plain, which can be furnished hook and eye, double hook, or double eye. These goods are standardized and constructed with a view of great strength being secured.

A NEW TYPE of standard base, 6-cp lamp, is being pushed to the front by the Central Electric Company, Chicago. This lamp is made for standard voltages, is 3½ inches long over all, and about 2 inches in diameter. It is said to be exceedingly economical of current, and will undoubtedly find popular use for signs and other purposes where low candle-powers are desired.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., in a circular to the trade, announces that it has commenced suit against a Washington firm for infringement of its electric fan patents. The suit is based on four patents, and as soon as these are judicially sustained, the Diehl Company states that it will proceed against all dealers in and users of infringing fans for damages and injunction.

MESSRS. KURZ & ROOT, consulting electrical engineers, Appleton, Wis., on May 16 opened an electrical repair shop in connection with their factory, and are now prepared to make repairs on short notice, such as rewinding armatures, fields and transformers, and repairing and standardizing burned out or defective electrical instruments, etc. Both Messrs. Kurz & Root are young men, and are qualified to render first-class service in their line.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is supplying all the structural steel work for the extensive additions to the gas producing plant of the United Gas Improvement Company, Philadelphia. The gas company is erecting a new boiler and engine room, a condenser building, a purifier building, a generator house and a meter house, all of which are of steel fram construction, brick side walls and slate room supported on metal purlins carried by clear, span trusses.

THE STERLING ELECTRIC COMPANY, Chicago, Ill., on account of the rapid increase in its business, finds it necessary to open a Southwestern office in St. Louis. Mr. H. A. Coit, formerly manager of the Missouri Telephone Company and one of the best-known men in the independent telephone field, will have charge of the Sterling Company's business in that territory, and will carry a full line of the company's samples and take charge of its Southwestern business. His office is located in the Laclede Building.

THE M. C. BULLOCK MANUFACTURING COMPANY, Chicago, Ill., reports that its business has been gradually and steadily improving for the past five or six months, and that its total shipments for the month of May aggregated more than the shipments of any month since the financial crash of 1893. The company is doing a large mining business, and several plants of this character are included in the list of recent shipments. Some of its mining apparatus has been shipped recently to Japan and Siberia.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to the new Whitney pocket voltmeter, which promises to find a large field of usefulness, particularly among telephone companies, where an accurate voltmeter of low range is desired. This instrument is about the size of an ordinary watch, and can be easily carried in the pocket. It has every advantage of a regular battery gauge, with the additional advantage of being an exact and accurate scale, instead of merely a comparative scale, as the battery gauges have heretofore been made.

THE PRISMATIC ELECTRIC SIGN COMPANY, Williamsport, Pa., reports that in spite of the fact that some people are finding business dull at the present time, it has been unusually busy. Its contracts for electric signs since June 1 have been very large, and shipments have been all over the United States, as the following list shows: Glenwood Springs, Col.; Atlanta, Ga.; Rochester, N. Y.; Pittsburg, Pa.; Little Falls, N. Y.; Washington, D. C.; St. Joseph, Mo.; Sacramento, Cal.; St. Louis, Mo.; Stroudsburg, Pa.; Southampton, N. Y.; Detroit, Mich.; Erie, Pa.; Buffalo, N. Y.; Syracuse, N. Y.; Bushnell, Ill.; Fort Smith, Ark.; New York City, N. Y.

THE MULLINIX ELECTRIC COMPANY, Cincinnati, Ohio, has been recently organized to manufacture a line of electrical specialties. Mr. C. L. Mullinix, general manager of the new company, was formerly a partner in the Ohio Electric Specialty Company, Troy, Ohio, which partnership has been lately dissolved. Mr. Mullinix was the designer of the "Perfection" dynamo brush made by the Ohio Electric Specialty Company. He has improved the brush, and it will be manufactured hereafter under the name of the Mullinix dynamo brush. The new company will also manufacture all the ordinary types of woven wire and leaf copper brushes, and other electrical specialties will be added.

THE ERICSSON TELEPHONE COMPANY, 20 Warren Street, New York City, will be represented at the Chicago Convention of the National Independent Telephone Association on June 30, July 1 and 2. The company has added to its already large line of telephones a complete line of domestic type instruments manufactured by itself, all of which are equipped with the Ericsson Swedish coal-grain microphone; all-metal, bipolar, never-changing receiver and induction coil. A line of these instruments will be exhibited at the Palmer House during the convention, and the company invites all independent telephone men to inspect them. The company is now importing the Ericsson Swedish induction coil on such terms that will meet with the general favor of the independent telephone people.

THE PELTON WATER WHEEL COMPANY has been awarded the contract for the hydraulic work of the new plant of the Central California Electric Power Company, to be installed at Auburn, Cal. This station is to embrace two 43-inch wheels, to run under 200-foot head, at 300 revolutions, and develop 800 horse-power. The wheels will be direct connected to a 500-kw Westinghouse generator, the power to be transmitted to the Newcastle station of this company, 6 miles distant, and to Sacramento over the same pole line. The entire distance from the Auburn station is 34 miles. The interesting features of this plant consist in running two stations so far apart in parallel; also in the double use of the water, it being the same that supplies the Newcastle station, 6 miles lower down. With the rapid fall of many mountain streams, power can thus be multiplied indefinitely and generally within reasonable limit of transmission.

THE AMERICAN WHEELOCK ENGINE COMPANY, Worcester, Mass., is meeting with success in installing the Greene-Wheelock engine. Among the plants now in course of erection or construction in its shops, and those recently installed are the following: Six 1500-hp engines for the Chicago City Railway Company, with rope drives; one 750-hp direct connected engine for the New York Heat, Light & Power Company; three 350-hp direct connected engines for the J. G. White Company, New York, and two 500-hp cross-compound, directed connected engines for the Potomac Electric Power Company, the latter being the second order, the previous order being for two 750-hp direct connected engines. The American Wheelock Company has installed at th Grosvenor-dale Electric Light Plant, Grosvenor-dale, Conn., the high pressure side of a cross-compound engine, putting its cylinder and valve gear onto a Corliss bed and replacing the Corliss cylinders. This is the second Corliss engine in this plant that has been replaced by the American Wheelock Company's cylinder and valve gear.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., has recently received a letter from Mr. M. J. Dillman, vice-president and general manager of the Capital Telephone & Telegraph Company, Sacramento, Cal., in which the writer makes some references to a recent suit which was decided in part against the Capital Company and in favor of the Western Electric Company, of Chicago. Mr. Dillman states that the suit was upon the alleged use by his company of a multiple switchboard, and was instituted on October 16, 1895. The first purchase made by the Capital Company, of the American Electric Telephone Company, was on or about February 15, 1897. The Western Electric Company obtained an injunction, Mr. Dillman states, restraining his company from using the boards in multiple. The American Electric Telephone Company, he says, has never used the boards in that manner and has no desire to do so. The Capital Company made a test of transmitters manufactured by the leading telephone manufacturers in the United States, and after a thorough investigation as to the merits of each instrument, decided to adopt the American Electric Telephone Company's telephones. Mr. Dillman reports that up to the present time he has failed to find anything on the market comparing with the new American Electrric Telephone company's solid back amplifying. transmitter for either long or short distance work under severe conditions.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

NEW WABASH FAST TRAIN EAST.—"The Continental Limited," a new fast train on the Wabash, now leaves Chicago daily at 12:02 noon, and arrives at Buffalo at 5 A. M., New York 3:30 P. M. and Boston 5:50 P. M, next day, with through car service. Ticket office, 97 Adams Street, Chicago.

UNITED STATES PATENTS ISSUED JUNE 21, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

605,850. ELECTRIC MOTOR; F. E. Briner, of St. Louis, Mo. App. filed August 21, 1897. The herein described armature for induction motors, the same comprising a laminated core formed with transverse grooves in its periphery, and induced-current-conducting bars arranged in said grooves, and having their ends bent so as to form a continuous short-circuiting band at each side of the armature, for said induced-current-conducting bars.

605,852. ELECTRIC METER; T. Duncan, of Fort Wayne, Ind. App. filed May 10, 1897. An electric meter provided with a cylindric armature, a shunt field within the armature, and a series field without the armature comprising separate horseshoe-shaped cores partially embracing the armature, and series coils wound upon said cores.

605,913. TELEPHONE TRANSMITTER; F. A. Ray, of Boston, Mass. App. filed August 18, 1897. In a telephone transmitter, an outer casing composed of two inseparable parts, back and front, a bridge diametrically of, but within the casing, combined with a screw-threaded boss to receive the arm of the instrument and a screw which unites the bridge with the boss to hold the back and front of the casing together as a unit.

605,915. ELECTRIC CLOCK-CONTROLLED SWITCH MECHANISM;

R. W. Rollins, of Hartford, Conn. App. filed Sept. 27, 1897. In an electric clock-controlled switch mechanism, the combination, with a pair of electric circuits, of a clock controlling said circuits and embodying a driving arbor, and two independently regulable circuit-controlling mechanisms, mounted on said arbor and insulated from each other, one for each of said circuits.

605,941. ELECTRIC BLOCK-SIGNAL SYSTEM FOR RAILWAYS; L. C. Werner, of Broad Brook, Conn. App. filed July 22, 1897. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of a vehicle moving along said track; a primary electrical register controlled by a block circuit; and a separately operative secondary electrical register controlled conjointly by the primary register and a block circuit.

605,949. ELECTRIC METER; T. Duncan, of Fort Wayne, Ind. App. filed June 24, 1897. An electric meter provided with a cylindric armature, a series field without the armature, and a shunt field within the armature comprising a cross-shaped core, and shunt coils upon said core.

605,953. CONTROLLING MECHANISM FOR ELECTRIC MOTORS; G. Gibbs, W. S. Johnson and H. Winkenwerde, of Milwaukee, Wis. App. filed May 10, 1897. In controlling mechanism for electric motors the combination with a rheostat, comprising a series of contacts and connected resistances and a movable contact arm, of an emergency switch, means tending to open said switch, a detent for holding the switch normally closed, means for disengaging said detent and releasing said switch, and means for automatically shifting the rheostat arm into starting position when said switch is opened, and for closing the switch when the rheostat arm is returned.

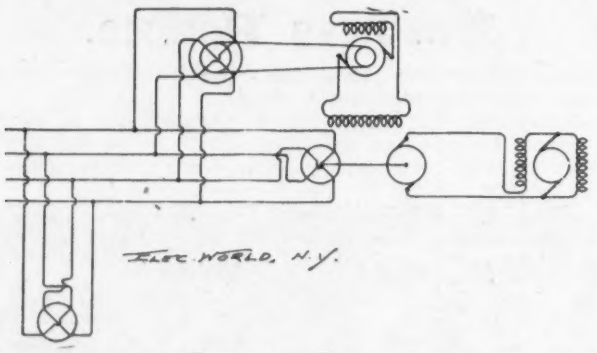
605,970. ELECTROMAGNETIC-SWITCH RAILWAY; A. Norman, of Toronto, Canada. App. filed July 3, 1897. In an electromagnetic-switch railway, a supply conductor, a sectional working conductor, switch boxes containing an L-shaped arm, four spring arms carried by the box and the arm respectively, having a contact with each other in pairs, and two plates and means for moving the plates vertically in an upward direction by the bridging of two of the sections of the working conductor and lowering the same by gravitation.

606,004. THERMAL CIRCUIT CLOSER; L. Emdin and J. A. Dewson, of Reading, Pa. App. filed Nov. 19, 1897. The automatic fire alarm, comprising a base, having a series of plates secured thereto, and in circuit with the alarm system, a spring designed to engage and hold said lever in a normally raised position, said lever being provided with depending arms or members, having lower curved ends designed to engage said plates, and means adapted to limit the movement of said lever under the action of said spring.

606,009. ELECTRIC CONTROLLER; M. W. Hanks, of Madison, Wis. App. filed Dec. 17, 1897. In an electric controller, the combination with a contact cylinder mounted on a rotatable shaft, of a second shaft provided with actuating means, and mechanism, interposed between the actuating means and the contact cylinder, comprising a projecting part on the cylinder shaft, engaging with a spring on the second shaft, whereby the contact cylinder may be instantaneously rotated, in either direction, to its consecutive positions, regardless of the velocity of the actuating means.

606,012. ELECTRIC CURRENT CONTROLLER; J. J. Hogan, of New Haven, Conn. App. filed July 15, 1897. In a current controller, the combination with an operating shaft carrying a resistance coil, of a carriage movable in a plane parallel with the axis of said shaft and carrying a contact finger which engages in said coil, a screw-feeding mechanism and a rack and pinion feeding mechanism, both of which are actuated by said operating shaft, and means for interchangeably connecting said carriage to said feeding mechanisms, whereby either mechanism can be utilized to impart movement to the carriage.

606,015. SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION; B. G. Lamme, of Pittsburg, Pa. App. filed Feb. 10, 1898. A system of distribution comprising a direct-current generator, a rotary transformer receiving current therefrom and supplying alternating currents to translating devices, a generator for exciting the field magnet of said rotary transformer, and means dependent upon changes in the amount of



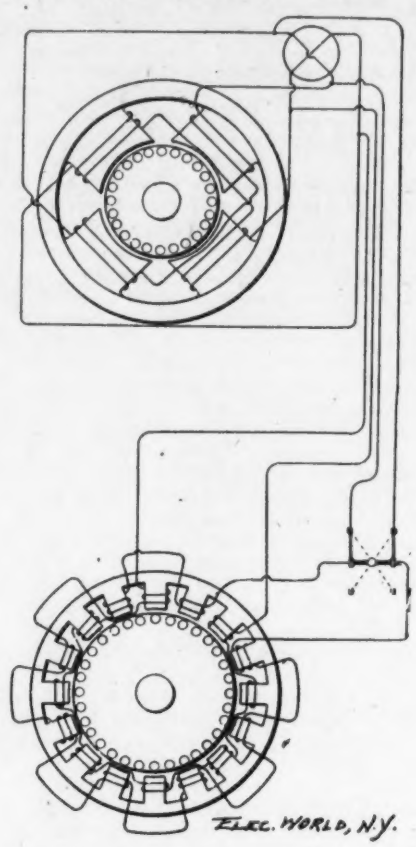
No. 606,015 —System of Electrical Distribution and Regulation.

inductive load on the alternating-current circuit or circuits for automatically varying the speed of the exciting generator.

606,033. MEANS FOR COMPENSATING FOR TEMPERATURE RESISTANCE CHANGES; C. F. Scott, of Pittsburg, Pa. App. filed Jan. 21, 1895. The combination with a movable armature, of shunt and series connected circuits inductive relation thereto, and non-inductive resistances of different values in the respective shunt-circuits, and one of which has a different temperature resistance from the other.

606,056. ALTERNATING-CURRENT ELECTRIC MOTOR; R. H. Hassler, of Pittsburg, Pa. App. filed Dec. 6, 1895. The combination, with two alternating-current induction motors, one of which comprises two independently movable members, and the other, a stationary and a movable member, of means for mechanically connecting one of the members of the first motor with the movable member of the second, a source of alternating currents, means for electrically connecting the primary member of each motor with said source of currents.

606,076. ELECTRIC ALARM SYSTEM; A. Ovenden, of Akron, Ohio. App. filed Sept. 24. 1897. In an electric-circuit closer, an inclined way, consisting of a plurality of independent super-imposed members, each comprising a conducting rail and a non-conducting rail having a portion of its face composed of conducting material, and a roller-circuit closer.

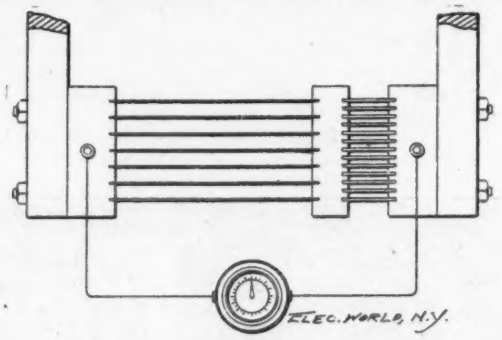


No. 606,056.—Alternating Current Electric Motor.

606,108. ELECTRIC ARC LAMP; F. Wright, of Newburgh, N. Y. App. filed Oct. 7, 1897. An arc lamp, comprising two magazines for containing carbons, tubes extended from the lower ends of said magazines and converging, carbon-locking devices on said tubes, means for automatically operating said locking devices, and stop-fingers on the tubes.

606,127. ELECTRODE FOR ARC LIGHTS; Chas. S. Dolley, of Philadelphia, Pa. App. filed Nov. 21, 1896. An electric arc electrode for use in connection with electric arc lamps, the same consisting of calcium carbide (Ca, C), of size, shape and resistance proportionate to the amount of current used.

606,162. TELEPHONE-EXCHANGE SYSTEM; W. W. Dean, of St. Louis, Mo. App. filed Feb. 6, 1897. In a telephone system, the combination with a telephone line extending from an exchange to a plurality of sub-stations, of a plurality of positively and negatively polarized bells and electromag-



No. 606.171 —Shunt for Electric Circuits.

nets connected therewith located at the sub-stations, mechanical means controlled by said electromagnets for preventing the actuating of said bells, and means at the central office for including said electromagnets in a circuit with direct current with positive or negative sign, and including said bells in circuit with ringing current of positive or negative sign.

606,171. SHUNT FOR ELECTRIC CIRCUITS; O. B. Shallenberger, of Rochester, Pa. App. filed April 22, 1897. A composite shunt, having a plurality of multiple resistances differently affected by changes in the temperature of the surrounding air, said resistances being connected to act conjointly in modifying the effect of said changes in temperature.